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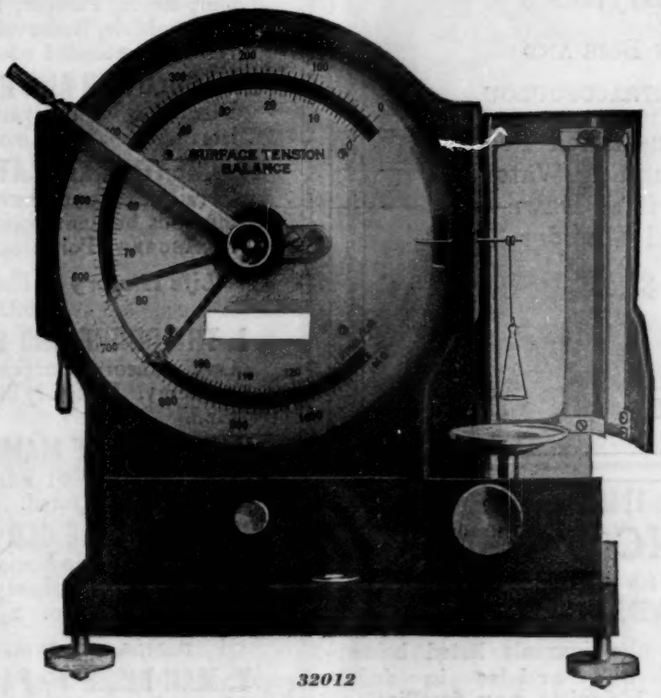

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary, in the Smithsonian Institution Building, Washington, D. C.

HOW THE OTHER HALF LIVE[1]

By Professor ROBERT HEGNER

THE JOHNS HOPKINS UNIVERSITY

THE title of my address this evening was called for by our secretary eight months ago; this made it necessary for me to select a title broad enough to cover anything I might wish to say. I was quite certain at the time that I would talk about parasites. I might equally well have chosen the title "How the Neglected Half Live" instead of "How the Other Half Live," since very few zoologists seem to realize what a large part of the animal kingdom consists of parasites. Those of us who have selected parasitology as a field of research know that every species of animal that has been studied carefully harbors within it one or more species of parasites. Man, for example, is known to be parasitized by about 25 different species of protozoa, 85 different species of worms and an uncertain number of different species of arthropods, the exact number depending on one's definition of a parasite. Many of these parasites appear to exist only in man. A similar condition prevails among domesticated animals and common wild animals and probably is universal. Hence it would appear that there are at least as many species of animal parasites as there are species of animal hosts for them to live in.

The number of individuals belonging to various species of parasites is astounding. The number of ciliates in the stomach of a cow, or cecum of a horse, the number of flagellates in the cecum of a guinea-pig, the number of malaria parasites in the blood of a human being suffering from malaria, and the number of amoebae in a dysenteric patient mounts into the billions.

Parasites have attracted more attention in recent

[1] Address of the vice president and chairman of Section F, American Association for the Advancement of Science, presented at the Zoologists' dinner in New Orleans on December 30, 1931.

years than formerly, but I believe zoologists in general still feel that there is some fundamental difference between free-living and parasitic animals and that the latter are of no particular importance as material for teaching purposes and research. This seems clear from the relatively small amount of space devoted to parasitology by teachers of zoology who have recently published text-books to fit their courses. For example, the "Invertebrate Zoology" used in the course at Woods Hole includes outlines for the study of 97 species of animals, only 5 of which are parasites. A text-book designed for courses in college zoology and written by well-known zoologists at the University of Missouri contains accounts of only three parasites and devotes eleven of a total of 585 pages to parasites and parasitism. A biology prepared for college students by a professor at Yale University contains 501 pages; two sections of this book comprising 22 pages are devoted to parasites. In a book on ecology written by a professor of zoology at Duke University, the subject of parasitism is relegated to the next to the last chapter and occupies 21 of a total of 417 pages. I feel free to criticize others for neglecting parasites in their text-books, since I have been guilty of the same offense.

Every one, I think, will agree with me that such a vast assemblage of animals deserves to be treated more fully than these statistics indicate is now being done. I should like to detail to you at some length the many advantages parasites present for biological study; how easily they may be obtained in large numbers; how interesting are their relations to their environment; how numerous are the problems of fundamental biological significance offered by them; and what great opportunities they give us, especially for the study of experimental evolution. However, because of lack of time, I will limit myself to a discussion of one group of parasites in a single host, namely, the protozoa of man.

For hundreds of years investigators have been studying the structure and physiology of the human body, and no other animal has ever been subjected to such careful and exhaustive examination. However, when all this knowledge has been assembled, it represents only half of the story. What is lacking is a knowledge of the fauna that use the human body as a residence, a food supply and a common carrier.

When one observes a relative or a colleague he may think he is seeing an individual, whereas, as a matter of fact, he is really looking at a menagerie. The human body may appropriately be compared to a zoological garden closed for the winter. The animals are there but one can't see them because they are kept concealed behind closed doors. Similarly the protozoan parasites of man are concealed from view because they all live inside of the body. But a proper examination will reveal them and I propose this evening that we take a peep through the keyhole into this marvelous assemblage of animal life.

The protozoan parasites of man may conveniently be divided into two groups on the basis of habitat. One group live in the digestive tract and are commonly known as intestinal protozoa. The other group live in the blood stream and are known as blood-inhabiting protozoa. These protozoa do not wander all over the body at will, but each of the 25 species that occur in man is definitely localized in some particular region of the body, just as free-living animals occupy definite habitats on the surface of the earth.

It is surprising to most people to learn that about one half of the general population are infected with a mouth-inhabiting amoeba. This organism lives in the tartar around the base of the teeth. It has been accused of being the causative organism of pyorrhea but has not been definitely incriminated. Transmission from one person to another no doubt takes place by contact. The logical conclusion is that those who are not infected have never been kissed. Human nature being what it is, there is no known method of preventing the spread of this amoeba. The other protozoon that lives in the mouth is a flagellate that is also probably non-pathogenic, although it occurs more frequently in diseased than in healthy mouths.

The two species of protozoa that live in the small intestine must be able to maintain themselves there against the rapid movement of food from the stomach to the large intestine. One type is a flagellate which possesses a sucking disc, by means of which it attaches itself to the intestinal wall to prevent being swept away. The other type is a coccidium which maintains itself by penetrating the cells of the intestinal wall. Coccidia are all pathogenic but are very rare in man.

The ten different species of protozoa that live in the large intestine are all more or less similar as regards their life histories. Most of them live in the lumen of the intestine and are harmless; but two of them, an amoeba and a ciliate, are responsible for the production of dysentery and are often lethal. Although 10 per cent. of the general population is infected with the dysentery amoeba, most of those infected are in the carrier condition, that is, although the organism is present, the human body is able to repair the damage caused by it so rapidly that no symptoms appear. This pathogenic amoeba is particularly prevalent in tropical countries and is responsible for thousands of deaths every year. Fortunately, several drugs specific for this organism have been discovered, and whereas formerly patients were almost certain to die in agony, now proper treatment just as certainly restores the patient to health.

The ciliate that causes dysentery in man is of considerable interest because we share it with monkeys and pigs; probably 80 per cent. of the pigs in this country have intestines swarming with this ciliate. Apparently they do not injure the pigs in any way, but the cysts that they produce are sometimes swallowed by susceptible human beings in whom they bring about dysenteric conditions. Most people are evidently not susceptible to this ciliate, since our food and drink must frequently be contaminated. A study of the cases that do occur reveals the fact that the patients had been associated in some way with pigs or had eaten insufficiently cooked pork products.

The other protozoan inhabitants of the large intestine of man are all supposed to be non-pathogenic, although certain protozoologists claim that several species of flagellates bring about intestinal disturbances. From about 5 to 50 per cent. of the general population may be infected with these intestinal protozoa. Inasmuch as no antagonism exists among these organisms and one person may be infected with the entire job lot assortment, it is probable that all but a very few of us have been unconsciously furnishing a residence and a food supply for several of these parasites and were totally ignorant of it. As a matter of fact, the material used in my laboratory at the Johns Hopkins University for the study of these protozoa is almost all furnished by the laboratory staff.

There is an interesting relation between these intestinal protozoa and the character of our diet. Meat-eating animals are not ordinarily infected with them, but vegetarians are very highly parasitized. This situation led to some experimental work which has demonstrated the effectiveness of animal proteins in preventing infection and of carbohydrates in intensifying infections. Casein seems to be the best of the proteins. A diet consisting largely of casein soon brings about a decrease in the number of certain organisms and often leads to their total elimination. Starch, on the other hand, provides a favorite article of food and results in an enormous increase of certain of these protozoa. The fact that rats fed on a high protein diet lost their intestinal protozoa suggested at once the treatment of human infections by modifying the diet. A series of menus were prepared in which animal proteins predominated, but which included such items as pickles and strawberries to make the food more palatable. The results when applied to human patients suffering from digestive disturbances due to certain protozoa were very striking; in many cases the protozoa disappeared along with the symptoms within a week. Two objections to this treatment have been reported; one patient was unable to get strawberries and another patient just couldn't eat pickles.

The blood-inhabiting protozoa of man are local in their distribution. The leishmanias, which cause kala-azar and oriental sore in the Far and Near East, and cutaneous ulcer in South America, are flagellate protozoa, all pathogenic and some of them very dangerous. The organism of kala-azar destroys thousands of human lives every year in Asia. Oriental sore is a disease that is called Delhi boil by the inhabitants of Bagdad, and Bagdad sore by the natives of Delhi. It is not a fatal disease, but leaves permanent scars in its wake. It is apt to occur on the face, being transmitted by a biting sand-fly. One attack gives immunity, hence it is the custom in certain eastern regions to inoculate children on some part of the body other than the face much as we vaccinate against smallpox. The resulting infection is mild, gives immunity and hence insures against facial disfigurement. It is becoming increasingly more difficult, however, because of modern styles of dress, to find a part of the body for vaccination that is not exposed.

Trypanosomes that are responsible for African sleeping sickness are also flagellates. They live in the blood stream and are transmitted from one host to another by tsetse flies. They are able to live not only in human beings but also in game animals, especially antelope; hence the flies have a constant reservoir from which they may become infected. Large sections of Africa are uninhabitable because of the presence of these protozoan organisms. Drugs have been developed in Germany, France and the United States that are effective against sleeping sickness if administered in the early stages of the disease. African sleeping sickness should be distinguished from Encephalitis lethargica, a type of sleeping sickness that occurs in this country and is an entirely different disease, the causative organism of which is still unknown.

Perhaps the most interesting of all the protozoa that live in man is the malaria organism. Malaria is undoubtedly the most important disease in tropical and subtropical regions and in some respects is the most important of all human diseases, since it is responsible for preventing the colonization of vast areas in the most fertile regions of the earth. As you all know, only female mosquitoes are able to transmit the disease, and even the female is quite innocent of any harmful intention, since she doesn't know the blood she sucks into her stomach is loaded. When she bites she regurgitates juices from her salivary glands into the blood stream of her victim, and in this salivary secretion are suspended the infective stages of the malaria organism. Malaria could easily be eradicated therefore, if we could teach mosquitoes not to spit. Malarial organisms occur in birds, monkeys and other animals as well as in man, but the bird malaria parasites are unable to set up in-

fections in human beings. We are not yet certain whether the parasites of man and monkeys are capable of setting up cross infections.

Much can be done to control malaria by killing mosquitoes, but there are still many problems unsolved. One of the most important of these is the problem of relapse. Quinine and the new drug plasmochin destroy most of the parasites in a patient and give relief from symptoms, but they do not ordinarily eliminate all the parasites and the host is thus in the carrier condition and liable to suffer a relapse at any time. What we need more than anything else to aid us in eradicating malaria is a drug that will destroy all the parasites in an infected person and thus prevent relapses. Many chemists and zoologists are now engaged in studies directed toward the discovery of such a drug.

Even if all the parasites are destroyed, we are in constant danger of reinfection. You probably all know about the student who was once asked to name a famous parasitologist of the past. "Milton," he replied, "because Milton wrote 'Parasites Lost' and 'Parasites Regained.'" The problem of reinfection must be solved by those who are in charge of our public health activities. As every one knows, the most conspicuous successes in the field of public health have been the campaigns for the eradication of such diseases as malaria and yellow fever. In fact, the residents of the Panama Canal Zone call a policeman if they are attacked by a mosquito.

Sometimes one type of parasite preys upon another type of parasite. An interesting and important case of this so-called hyperparasitism that has attracted wide-spread attention during the past decade is that of the effects of malaria on general paralysis or paresis. Malarial organisms, when inoculated into patients suffering from general paralysis, bring about a distinct improvement in the course of the disease. Patients are allowed to go through eight or nine malarial chills and fever and are then treated with quinine to check the malaria. The results of investigations of this type carried on in various parts of the world have almost all been favorable.

This review of the protozoan parasites that live in man may serve to refresh your memory regarding these interesting animals, but to determine satisfactorily how the other half live it is necessary to follow their entire life cycle from the invasion of a host to the escape of the offspring from that host. Much research is necessary to work out life cycles and the view-points of investigators working in several different fields must be combined before a satisfactory ensemble is attained. Zoologists are primarily interested in the taxonomy, morphology, physiology and development of the parasite; medical men are more interested in the reactions of the host than they are in the parasitic organisms that cause the diseases; and students of hygiene and public health emphasize those phases in the life cycle that have a bearing on the transmission of the parasite from one host to another.

I have attempted to combine the view-points represented by these three types of investigators into one program which I call "Host-Parasite Relations." In this program the events in the life cycle of the parasite, the reactions of the host to the invasion of the parasite, and the transmission of the parasite from one host to another are arranged in logical order beginning with the exogenous existence of the organism. Such a program may be compared with the study of a free-living protozoon involving the investigation of its life cycle, the interactions between it and the environment and its geographical distribution. There is no real difference between free-living and parasitic protozoa except that of environment, and the environment of parasites appears to be remarkably similar to that of free-living animals when the two are analyzed carefully.

Perhaps the best stage with which to begin a study of host-parasite relations is that during which the organism is transmitted from one host to another. Among human protozoa this is accomplished either by an intermediate host, for example by mosquitoes in malaria or tsetse flies in sleeping sickness, or by cysts that are swallowed in contaminated food or drink as in amoebic dysentery. It can not be too strongly emphasized that the parasite is passive and the host active during transmission and that consequently we are responsible for our own infections, either because we fail to prevent mosquitoes or other blood-sucking insects from biting us or because we allow our food and drink to become contaminated with fecal material containing protozoan cysts.

After gaining entrance to the body the protozoa are distributed to the primary sites of infection either in the blood stream or by the movements of the alimentary canal. This distribution is brought about almost entirely by the physiological activities of the host, the parasite remaining passive. The site of infection, whether the red blood cells, blood plasma, endothelial cells, muscle cells, mouth, duodenum or colon, is no doubt largely determined by the reactions of the different parasites to various stimuli; just as free-living protozoa become localized in particular types of habitats in a pond or in the ocean.

During the period when a protozoan parasite is becoming established in the human body there is a struggle going on between host and parasite. The host exhibits a natural resistance to infection which the parasite must overcome. For example, the acid condition of the stomach contents is detrimental to active protozoa; this obstacle is overcome by intes-

tinal protozoa by the production of cysts whose walls resist the action of the digestive juices and enable the organism to pass through the stomach unharmed. To a zoologist who has attempted to rear pure lines of free-living protozoa, one of the most remarkable features involved in the life cycles of parasitic protozoa is their ability to remain vigorous for an indefinite number of generations in a medium that is practically constant in temperature, density, chemical composition and food content. For example, the parasite of bird malaria with which we have worked in my laboratory for the past twelve years was obtained by Dr. Eugene Whitmore from an English sparrow in Brooklyn, N. Y., in 1913 and has lived in canaries ever since, multiplying once per day by asexual reproduction without the intervention of sexual reproduction or endomixis and without any perceptible loss of vigor. During this period these parasites have passed through over 6,600 asexual generations.

The interactions of host and parasite result in various changes in both organisms. If the host does not successfully resist the parasite it suffers injury, as evidenced by the appearance of symptoms which may lead to death. Or the host may build up resistance against the parasite, thus becoming immune and recovering from the attack. Often an equilibrium is established between host and parasite, the injuries of the host being repaired as rapidly as inflicted; the host thus becomes what is known as a carrier. Any change in the host that lowers its resistance and any change in the parasite that increases its virulence upsets this equilibrium, and the attack of the parasite again brings about the appearance of symptoms.

One of the most interesting phases of our program is that of host-parasite specificity. In many cases a particular species of host is parasitized by species of protozoa that occur in no other species of animal. Thus the 25 species of protozoa known to live in the human body are rarely found in lower animals. The rat, for example, which is so closely associated with man and lives on a somewhat similar diet, is parasitized by at least seven species of protozoa that belong to seven genera represented among human protozoa; these seven species, however, are morphologically different and may easily be distinguished from species belonging to the same genera in man. This is not true when the protozoa of man and monkeys are compared. Of the 25 species that live in man, 20 indistinguishable from them have been reported from monkeys and only 3 species have been recorded from monkeys that are not known to live in man. The assumption is reasonable that animals whose parasites resemble each other closely are near of kin. If this is true, we may add the species identity of parasitic protozoa to the other types of evidence that lead us to believe in the close kinship between monkeys and man.

The protozoan parasites that I have described this evening are considered to be normal inhabitants of the human body, and all of us probably serve as hosts for one or more species. The expression "we all" often applied by Southerners to a single person appears, therefore, to be quite appropriate. In many regions, where such diseases as malaria occur, every human being is infected from soon after birth until death. Fortunately for us, most of our protozoan parasites are not destructive, and we carry them about with us unharmed. It isn't pleasant, however, to realize how many millions of creeping microbes use our bodies as a protozoan universe, and it is natural for us to want to do something about it. Much has been done and is being done. Malaria, amoebic dysentery, sleeping sickness and other protozoan diseases of man have lost much of their terrors because therapeutic agents and methods of control have been discovered and put into practice.

However, protozoology needs more publicity than it has at present; probably not one person in a carload even knows that such creatures as protozoa exist. Perhaps, in course of time, biologists may be able to defaunate the human body and thus initiate a race of supermen. Modern facilities for rapid transit are, however, making this continually more difficult. Disease-producing organisms may be transported from one locality to another and for long distances either by human carriers or by intermediate hosts. The intermediate hosts of protozoan parasites are usually flies and bloodsucking insects; these are frequently transported from one country to another. It is usually not necessary, however, to take drastic action for the purpose of preventing the importation of animal parasites into the United States because of their complicated life-histories. For example, trypanosome diseases can not be transmitted in a locality where certain species of tsetse flies are absent, even if animals with trypanosomes in their blood are present in large numbers.

One field in which the study of the protozoa of man has taken a leading rôle is that of rendering the tropics as habitable for man and his domesticated animals as are the temperate regions of the earth. Such conquests as that of malaria and yellow fever in Havana and the Panama Canal Zone have a distinct bearing upon one of the greatest problems before mankind at the present time—the problem of population. Statistics show that the world's population has increased about two and one half times during the past century. Many methods of preventing further increases in population have been suggested, but no one can predict what the future may have in

store for us in this direction. We must, however, face the problem that confronts us to-day. In tropical countries large areas of land exist that are now sparsely inhabited and unproductive. That these tropical regions can be made healthful to men from the colder regions of the earth has been proved again and again by various nations that have founded colonies in the torrid zone. To do this it has only been necessay to control certain diseases, and these diseases have been for the most part due to animal parasites or their transmitting agents.

My remarks this evening may lead you to believe that we think we really know something about the protozoa of man. This, however, is far from the truth. One has only to look back to the situation that existed 30 years ago to realize our own position to-day. Zoologists in 1900 believed that they were living in an enlightened age, but now we know that they were densely ignorant. It seems probable that in 1960, 1931 will likewise be considered among the zoological dark ages. Hence, although we have made a good beginning in the study of parasitic protozoa we must continue our efforts until we are able to escape from the humiliating condition that exists at the present time and man ceases to be held in bondage by his invisible fauna.

OUR DEBT TO FARADAY'S EPOCH[1]

By Professor DUGALD C. JACKSON
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ONE hundred years ago the first third of the nineteenth century was drawing to a close, as now is the first third of the present century. You may reflect that the stated facts are obvious and that the whole statement is a platitude. I center your attention on them with the clearly defined purpose of emphasizing the debt which we, in this first third of the present century, owe to discoveries originating in that significant first third of the immediately past century.

Using that first third as a landmark: James Watt, the founder of mechanical engineering, had already proved the usefulness of his conception of the steam engine; Lavoisier, the father of modern chemical thought, had just been guillotined by the revolutionists in Paris. Science and engineering had taken on new aspects, and the spirit of inquiry was abroad in a newly felt freedom.

Exclusive of those features of sentiment and religion, which must be dealt with independently because they are primarily of intellectual and spiritual moment, rather than pertaining to the physical conditions of health, comfort and convenience of the body, we are primarily dependent in our present-day living methods on a few great modern developments. Preventive medicine, sanitation, sound food preservation, transportation by water, rail and highway, electric quick communication, ready transmission of power, convenient artificial illumination, largely determine our relatively great assurance of health and comfort in life compared with the conditions of a couple of centuries ago.

I wonder whether any of you express to yourselves and associates doubts regarding the relative advantages in favor of our present status measured in health, comfort and opportunities for all men and women in the democratic countries, compared with the conditions of the common people of the great countries of a few generations ago. If you do, I assure you that it is because you have failed to study the effect of the changes of conditions; or, having studied them, you have failed to accurately interpret their meaning. When I speak thus in comparative favor of our own times I refer not only to average opportunities for health, comfort and happiness in life, but also to the conditions available particularly for those who are little favored with influence or money.

If you wish a bit of my meaning more fully illustrated, I invite you to drive through the Värmland and Dalecarlia provinces of Sweden, as my wife and I did last summer in a pigrimage to the birthplace, school place and tomb of John Ericsson. And then compare, feature by feature, the present comfortable, well-supplied life of the present dwellers, living secure in that community, with the sordid hardships of the life there several generations ago, which are identically described by Selma Lagerlöf in her distinguished saga of Gösta Berling. I am sure that the sordidness and hardships of the older life and the relatively healthful, comfortable and happy conditions of the present life in the area will impress you. The changes are revolutionary and heavily favorable to the present. Food is now certain for all. Children are born under sanitary conditions and with suitable medical aid. The sick are properly cared for. Products of the farms, forests and mines are of definite value. Reasonable periods of sleep and recreation are within command of all. Shelter and clothing are assured. This makes a deep-seated contrast with the

[1] Address delivered at the celebration of Faraday's life held in New York on November 18, 1932, by the New York Museum of Science and Industry.

conditions in the older period; and the healthier and happier hues are mostly associated with the later period.

We may reasonably ask how this difference has come to pass. The answer is in terms of enlarged science and broadened engineering; in rail transportation and steam navigation, automotive highways, quick electrical communication by telegraph and telephone, ready transmission of electric power generated from water-power, convenient sources of artificial illumination, preventive medicine and sanitation. One swallow does not make a summer nor one snowflake a winter, but the given example is indicative. A scientist is skeptical in drawing conclusions (and the competent engineer is a scientist), but he does not misconstrue facts and determined relationships. One of the hindrances which occur when one tries to secure a fair and accurate understanding, from such a comparison of the present with the past, lies in the difficulty of divesting a mind of present-day knowledge when considering the past, and thus the conditions of the past are given an interpretation which is unduly favorable because it is flavored by knowledge extracted from the present. Critics of our present-day social organization frequently fill with this error the comparisons which they make. Obviously there are faults in our present social organism. We all know that they are many and are sometimes grossly unfair as between men; but they are not so many or so unfair as in previous centuries. To prescribe a cure calls for keener relating together of facts than usually characterizes self-constituted social physicians.

But that first third of the nineteenth century—what of it and why our debt to it?

In the early part of that period, Fulton, the father of steam navigation, produced the first operating embodiments of the steamboat, the conception of which had come to him a few years earlier. George Stephenson, the father of railroad transportation, in this period wrought out in metal his conception of the iron horse as a device with smooth wheels running on smooth rails and yet capable of drawing after it great loads; and in 1829 he conclusively proved against all skeptical opinion that his device outclassed horses as a motive device. Morse had his great conception of the electric telegraph during the period, although it was some years later before he succeeded in embodying his conception in a successfully working telegraph structure, and it was some decades more before Bell produced the telephone. Faraday, the gifted experimenter in the fields of chemistry, metallurgy, electrochemistry, electricity and magnetism, in that period laid the foundation for all our electrical power and electrical illumination developments.

There, in that one third of a century, lie the roots of all our developments of steam navigation, rail transportation and electric communication which have made, for most of the world, one harvest; and in the end will apparently succeed in making it of one heart.

Our hearts are torn by pathetic accounts of drought and flood and succeeding famine in the central provinces of China. We, in this country, which is bound indissolubly together with bonds of quick communication and efficient transportation, find it difficult to believe that starvation following failure of crops in inland China is due mostly to ancient and rudimentary means of communication and transportation, and not to mismanagement. But such are the facts. A short century ago, starvation of populations by famine was of common-place occurrence after the failure of crops in almost any of the inland provinces of India, which country has a population measurably in keeping with that of China. Today the occurrence of famine in acute degree in India is beyond the margin of our thought. This change in India has been wrought mostly by the wonders of electric telegraphy and steam railroad transportation.

As recently as when I was a boy severe shortages of the potato crops in some districts of Ireland caused famine-starvation to a degree and with a frequency that led that island to be sympathetically referred to as the Stricken Isle. What of the present day in that isle? How many of you under forty have thought of ravages of famine decimating the Irish population? The differences distinguishing the present conditions and those of the not far distant famine days of Ireland include the influences of more scientific cultivation of crops, improved sanitation, and recently the convenient provision of electrically transmitted power; but the major changes have been in the wake of railroad transportation and electrical communication.

When the great people of China have knit their nation together with bonds of electric telegraphy and telephony, railroad transportation, automotive highways and convenient electric power lines, their inland provinces will no longer be periodically ravaged by famine and pestilence, as the facilities for transportation and communication will give means for forefending against those great disasters.

This is enough of the "particular instance" to emphasize the point, and perhaps as much as your interest will support. You will observe the ameliorating influence of rail transportation, electric communication and electric power on the conditions of life. This may seem purely materialistic to some; but that is a misinterpretation, since intellectual qualities grow greatest where material opportunities are favor-

able, even though such opportunities may be embraced in only a Bohemian or partial manner. Moreover, improved communication and transportation have strongly advanced the influence of the premier invention of printing on the culture and mutual sympathies of the world, and have largely expanded the radius of spiritual influences.

You will note also the insistence with which electric communication and electric power appear in the recital. These have their roots in the magnificent discoveries of Faraday, Joseph Henry and others in that third of a century which we have been considering. Their growth has been extended by the discoveries and inventions of many others working in distinguished ways from then until the present day.

Fundamental discoveries which bring such great results are the fruits of curiosity working under ideal conditions; that is, of the spirit of inquiry applied to the disclosure of new facts or inferred relations. With increasing rarity they are the result of one scientist's efforts, although that was a characteristic of Faraday's days. An entire laboratory group, perhaps working under some inspired leader, nowadays more often brings projects to successful conclusions. Utilizing both of these sources—individual genius and group cooperation—we have admirable centers in the university laboratories (including therewith laboratories of the engineering schools) to carry forward in paths corresponding to those that have led to such impressive improvements in the conditions of healthfulness, comfort and happiness of life for all individuals coming under their influence.

The extraordinary influence of the universities heretofore is worth briefly enumerating, but I have time to sketch the affair in one branch only, and I will choose electrical engineering, in regard to which I am best informed. Galvani, Volta, Oersted, Ampere, Ohm, Joseph Henry, Maxwell, Kelvin, Helmholtz, Hertz, Roentgen, Pupin and other discoverers of natural phenomena or expounders of relations upon which most of the structure of electrical engineering is founded, worked in university circles. Alexander Graham Bell was professionally a teacher, although his great invention of the telephone can not fairly be accredited to educational laboratories. Elihu Thomson was originally in the post of a teacher and many of his widely influential inventions arose from experimental investigations performed in those days. Faraday's location during his great discoveries in chemistry, electromagnetism and other branches of physics was in the Royal Institution, which was founded by Sir Joseph Banks, Count Rumford and others with objects which include "the facilitating of mechanical inventions, the promoting of their use and the teaching of science and its applications by means of lectures and experiments."

The impulse of curiosity or spirit of inquiry, which scientific investigation or research is the embodiment, is well nurtured in the university atmosphere, where the relations of science are brought to bear on enthusiastic young minds. It is an integral part of properly conceived engineering education and is especially serviceable in those institutions where the students are encouraged to independent scientific investigation and thought. The result of newly vitalizing this view in engineering education is bringing good results where it is in effect. This experience gives assurance that we may rely on our present generation to work some of the faults out of our social organism and carry forward the improvement of modes of life by farther application of scientific discovery. One of the needs is to provide the better engineering schools with means to as closely associate their work with fundamental economics as they are now associating it with fundamental science.

We have now considered briefly some of the achievements which were made in the first third of the nineteenth century, that expired nearly one hundred years ago, and also the effects of those influences on our present-day life. Shining forth amongst it all is the glorious significance of Faraday's own work, which exemplifies

> . . . the vital words and deeds
> Of minds whom neither time nor change can tame.

OBITUARY

IN COMMEMORATION OF STEPHEN TYNG MATHER

IN memory of Stephen Tyng Mather, founder and former director of the National Park Service, who died two years ago, the first of the bronze plaques designed by Mr. Bryant Baker, of New York, for The Stephen T. Mather Appreciation, of which Mr. John Hays Hammond is chairman, will be unveiled in Mount Rainier National Park on July 4, Mr. Mather's sixty-fifth birthday anniversary.

The plaque is oblong in shape, measuring 30 by 3[illegible] inches. The deep interest of Mr. Mather in outdoor life inspired the design, at the right of which, against a background of mountain ranges, is presented in bas *relief* his portrait looking toward a group of trees. Above the portrait is the legend:

> Stephen Tyng Mather, July 4, 1867—January 22, 193[illegible]

Below it, across the base of the plaque, is the following inscription:

He laid the foundation of the National Park Service, defining and establishing the policies under which its areas shall be developed and conserved unimpaired for future generations. There will never come an end to the good that he has done.

A plaque is being placed on the south rim, near Yavapai Point, of Grand Canyon National Park in Arizona, and another may be placed along the north rim. Sites are being chosen for plaques in Yosemite, Yellowstone and Zion National Parks and officials hope that unveiling ceremonies may also be held in these parks on July 4.

Plaques will be placed during the summer at Logan Pass in Crater Lake National Park in Oregon; Grand Teton in Wyoming; Rocky Mountain and Mesa Verde in Colorado; Lassen and Sequoia in California, and Mount McKinley in Alaska.

The plaques will be placed in the national parks by the Park Service. The Stephen T. Mather Appreciation is prepared to provide plaques for all the twenty-two parks and to provide and place one in each of the thirty-four national monuments included in the National Park System.

Placement of a plaque near Chinook Pass at the highest elevation of the Mather Memorial Highway, which crosses the Cascade Range east of Rainier National Park, is awaiting choice of a site, and arrangements are being made to put another in Mather Grove on Redwood Highway between Miranda and Dyerville, California.

Friends of Mr. Mather are to plant a grove of trees on the campus of the University of California, of which he was a graduate, and for this memorial also, at the request of officials of the university, a plaque will be provided.

MEMORIAL TO THOMAS ALVA EDISON

A DESIGN for an Edison Memorial Museum and eternal light at Menlo Park has been approved by the Edison Parkway Commission of Perth Amboy, New Jersey, and was presented by its chairman, Joseph F. Deegan, to the Edison Pioneers at their annual dinner on February 11 in New York City.

According to the plan, the building, designed by Colonel Hugh A. Kelly and Mr. John B. Peterkin, would cost $850,000. It would be circular in shape, measuring 180 feet across, and would be surmounted by a shaft reaching to a height of 175 feet. This would be surmounted by a translucent globe with the hemispheres indicated upon its surface and lighted internally and externally.

Not only would the building serve as a memorial and tribute to Mr. Edison, but as a museum to preserve for posterity objects associated with his life and works.

The plans show four entrances to the building. They lead into a rotunda which would be centered by an Edison statue. Murals depicting dramatic scenes from the inventor's life would cover the surrounding circular walls. In style the building would be a modern adaptation of the Greek, simple and dignified, but with an expression of rising strength in the shaft supporting the illuminated globe. The exterior would be of marble and limestone.

MEMORIALS

FORMER students in chemistry at the Johns Hopkins University, including non-graduates, have organized the Chemistry Alumni of the Johns Hopkins University with Dr. Henry N. Holmes, of Oberlin College, as president and Dr. Lyman C. Newell, of Boston University, as secretary. Two meetings are held each year, ordinarily at the time of the meetings of the American Chemical Society. At the last meeting it was voted to establish "The Remsen Memorial Collection," and a committee consisting of Dr. Lyman C. Newell, *chairman;* Dr. John C. Olsen, Polytechnic Institute, Brooklyn, New York, and Dr. E. Emmet Reid, of the Johns Hopkins University, was appointed to take charge of the matter. The committee at present is anxious to obtain early portraits of Dr. Remsen, autograph letters on scientific subjects and inscribed copies of the first, or an early, edition of his books, particularly books in a foreign language. Colleagues, associates, students and friends of Dr. Remsen who have memorabilia of this kind are requested to write the chairman of the committee, Dr. L. C. Newell, 688 Boylston St., Boston, Massachusetts.

THE Medical Society of the District of Columbia held exercises on January 13, in memory of Dr. George Martin Kober, a former president of the society and for many years dean of the Georgetown University School of Medicine. Dr. Kober died on April 24, 1931. Addresses were made by Dr. Henry C. Macatee for the medical society; Rev. W. Coleman Nevils, S.J., for Georgetown University; Mrs. Ernest R. Grant, for the Washington Tuberculosis Association; Surgeon General Robert U. Patterson, for the medical corps, U. S. Army; Mr. George S. Wilson, for the board of public welfare of the District; Dr. Aleš Hrdlička, for the Anthropological Society of Washington. Dr. Arthur C. Christie, president of the society, was chairman of the meeting, which was open to the public.

IN the presence of a distinguished gathering of American and French officials and airmen a monument was dedicated on January 30 to the memory of Wilbur Wright at the field of Pontlong, five miles

from Pau, where Mr. Wright set up the first flying school in the world nearly a quarter century ago. The monument, executed by a Pau sculptor named Gabard, is in the form of a tall shaft with a bronze plaque. It was given by Mr. Frederick Prince, a New York banker, one of whose sons, an aviator, was killed during the war.

IN commemoration of the one hundredth anniversary of the death of Laplace (in 1827) a memorial monument will be erected in the town of Beaumont, his birthplace. Dedication will take place in the summer of 1932.

RECENT DEATHS

JOHN WESLEY YOUNG, Cheney professor of mathematics at Dartmouth College since 1911, has died at the age of fifty-two years.

PROFESSOR HAROLD BABBITT SMITH, retired, for thirty-five years head of the department of electrical engineering at the Worcester Polytechnic Institute, a former president of the American Institute of Electrical Engineers, died on February 9, at the age of sixty-one years.

A CORRESPONDENT writes: "William P. Headden, for a long time chemist of the Agriculture Experimental Station at Fort Collins, Colorado, died at his home at Fort Collins on February 5. He was professor of chemistry at the Colorado State Agricultural College since 1894, but later gave his entire time to the experimental station work and as such prepared many papers on investigations of soils, on plants, notably on the development of sugar in sugar beets, the formation of nitrates and their influence, etc. These led to many other papers. Dr. Headden was born in 1850 and therefore was nearly eighty-two years old. His work was of a very high character."

GILBERT ALBION BRAGG, general manager of The Koppers Research Corporation, Pittsburgh, Pennsylvania, died on February 2, at the age of forty years. He was a research chemical engineer who gained recognition as an authority on hydrometallurgy and later as a specialist in gas purification. Mr. Bragg held one of the first industrial fellowships at the University of Kansas, called the Robert Kennedy Duncan Fellowship No. 2, prior to the transfer of the Industrial Fellowship System to the Mellon Institute in Pittsburgh.

THE death is announced in his eightieth year of Geheimrath Dr. Max Von Frey, professor of physiology at the University of Würzburg. Dr. Von Frey was especially known for his studies of sensation and the peripheral sensory forms. His last visit to the United States was in 1929 when he lectured in Minnesota and attended the International Congress of Physiology in Boston.

PROFESSOR EDUARD KAUFMANN, formerly ordinarius in pathology at the University of Göttingen, has died, at the age of seventy-two years.

A CORRESPONDENT writes: "General Gustave Auguste Ferrié died in Paris on February 16, 1932, following an operation for appendicitis. General Ferrié held a very important position in the field of science, having been for many years member of the Institute of the Academy of Sciences of France, Commander of the Legion of Honor, correspondent of the Bureau of Longitudes, and Inspector General of the Military Telegraphic Service of France. He was president of the International Radio Congress held in Washington, D. C., in 1927. He was one of the delegates from France to recent conventions of the International Geodetic and Geophysical Union, and was chairman of the Committee on World Longitude Determinations. He perfected plans for the cooperation of many countries in the determination of longitudes around the world in 1928 for the purpose of testing the Wegener Hypothesis, and, at the time of his death, he was engaged on plans for a repetition of this work during the year 1933. He was born on November 19, 1868. In addition to being an eminent scientist, General Ferrié was a man of charming personality who had many scientific friends throughout the world. His death is a loss to science and to every one who had the pleasure of knowing and working with him."

SCIENTIFIC EVENTS

THE AMERICAN CHEMICAL SOCIETY

MORE than 1,000 men of science from all parts of the country will assemble in New Orleans from March 28 to April 1 for the eighty-third meeting of the American Chemical Society.

In several hundred papers and addresses to be presented from the laboratories of the nation's industries and universities, achievement in chemistry, which has gone on uninterruptedly during the economic recession, will be reported, according to an announcement by the president of the society, Dr. L. V. Redman, vice-president and director of research of the Bakelite Corporation, Bloomfield, New Jersey.

Speakers in a symposium on "Chemical Engineering Processes in the Oil Industry" under the chairmanship of Dr. R. T. Haslam, vice-president of the Standard Oil Development Company, will be Dr. Merrell R. Fenske, Pennsylvania State College; Al-

fred Fisher, Jacque C. Morrell and Gustav Egloff, Universal Oil Products Company, Chicago; Dr. Warren K. Lewis, Massachusetts Institute of Technology; Charles Allen Thomas and William H. Carmody, Thomas and Hochwalt Laboratories, Inc., Dayton, Ohio; J. B. Maxwell, Standard Oil Development Company, New York; S. N. Obryadchikoff and W. A. Peters, Jr., E. B. Badger & Sons Company, New York. Other speakers include representatives of the University of Michigan, the Standard Oil Company of Louisiana, Humble Oil and Refining Company, the Kellogg Company, the Standard Oil Company of Indiana and Alco Products.

Other sessions will deal with the progress of chemistry in the upbuilding of industry, with the problems of medicine and public health, and with developments in pure science, in agriculture and food, in chemical education, in gas and fuel, and in water, sewage and sanitation.

The opening event is a meeting of the council on Monday morning, March 28, President Redman presiding. On Monday afternoon there will be a general meeting, at which a group of special papers will be presented by men prominent in various fields. These include Mr. H. A. Gardner, president of the H. A. Gardner Laboratory, Washington, D. C., who will discuss "Tung Oil and its Production in the South" and Mr. Thomas Midgley, Jr., of the General Motors research staff, internationally known as the inventor of ethyl gasoline, will speak on "Fluorination."

Technical sessions will be held on Tuesday and Wednesday. The Division of Biological Chemistry, headed by Professor L. A. Maynard, of Cornell University, plans to hold a joint meeting on Tuesday afternoon with the Division of Agricultural and Food Chemistry, of which Professor Henry A. Schuette, of the University of Wisconsin, is chairman, and a symposium on "Pre-Medical Chemical Education" with the Division of Chemical Education, of which Professor O. L. Shinn, University of Pennsylvania, chairman, and the Division of Medicinal Chemistry, with Dr. Oliver Kamm, director of research, Parke, Davis and Co., Detroit, chairman. The Division of Biological Chemistry will also hold two general sessions.

The Division of Chemical Education, in addition to the joint meeting with the Division of Medicinal Chemistry and the Division of Biological Chemistry, has scheduled three half-day sessions, one being the meeting of the senate and standing committees. On Tuesday local teachers of chemistry will be invited to attend the meetings of the division and to be present at the luncheon.

The Division of Industrial and Engineering Chemistry, of which Professor D. B. Keyes, of the University of Illinois, is chairman, is sponsoring the oil symposium, in which the Division of Petroleum Chemistry, of which Cary R. Wagner, chief chemist of the Pure Oil Company, Chicago, is chairman, and the Division of Gas and Fuel Chemistry, of which J. D. Davis, research chemist of the United States Bureau of Mines, Pittsburgh, Pennsylvania, is chairman, will collaborate.

The Division of Petroleum Chemistry will also hold two half-day sessions for papers on other petroleum chemistry subjects. The Division of Medicinal Chemistry, besides its joint session with the Divisions of Biological Chemistry and Chemical Education, will hold one or more half-day sessions. The Division of Physical and Inorganic Chemistry, under the chairmanship of Professor H. H. Willard, of the University of Michigan, in addition to a joint symposium on "Adsorption" with the Division of Colloid Chemistry, headed by Dr. E. O. Kraemer, research chemist of the du Pont Co., Wilmington, Delaware, will hold two half-day sessions.

Other professional divisions of the society which have arranged programs for Tuesday and Wednesday and their chairmen include: *Cellulose,* Fred Olsen, director of research, Western Cartridge Company, East Alton, Ill.; *History of Chemistry,* Professor Lyman C. Newell, Boston University; *Organic Chemistry,* Professor Homer B. Adkins, University of Wisconsin; *Paint and Varnish,* Harley A. Nelson, research chemist, New Jersey Zinc Company, Palmerton, Pennsylvania; *Sugar,* W. L. Howell, chief chemist, Custom House, U. S. Treasury Department, New Orleans; *Water, Sewage and Sanitation,* A. S. Behrman, chief chemist, International Filter Company, Chicago.

Group dinners and luncheons, inspection trips to Louisiana industries and to points of historic interest, including the Vieux Carré, and a public address and a musical entertainment at the Roosevelt Hotel, where registration will be carried on beginning on Sunday, March 27, are among many features arranged by the General Convention Committee, of which Dr. C. E. Coates, of Louisiana State University, is honorary chairman.

NATIONAL RESEARCH FELLOWSHIPS IN THE BIOLOGICAL SCIENCES

THE Board of National Research Fellowships in the Biological Sciences, which includes within its scope the fields of anthropology, psychology, botany, zoology, agriculture and forestry, held its first meeting in 1932 on February 5 and 6, and made eleven reappointments and twelve new appointments for the academic year 1932–33, as follows:

REAPPOINTMENTS

For domestic study

S. H. Bartley—Psychology
G. W. Beadle—Agriculture
Wm. F. Hahnert—Zoology
E. W. Hopkins—Agriculture
T. L. Jahn—Zoology
M. L. Lohman—Botany
F. E. Meier—Botany
B. H. Schneider—Agriculture
B. F. Skinner—Zoology

For study abroad

H. H. Jasper—Psychology
F. K. Sparrow—Botany

NEW APPOINTMENTS

For domestic study

W. C. Bramble—Forestry
R. T. Hill—Zoology
I. T. Kelly—Anthropology
D. G. Marquis—Psychology
O. H. Mowrer—Psychology
M. M. Rhoades—Botany
G. B. Saunders—Zoology
G. L. Walls—Zoology
R. E. Zirkle—Botany

For study abroad

F. S. Howlett—Agriculture
M. J. Johnson—Agriculture
Albert Tyler—Zoology

A second meeting for further appointments for 1932–33 is planned for about April 28 and 29, and applications for consideration at this meeting should be filed not later than March 15. Information and application forms may be obtained from the Secretary, Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

WILLIAM J. ROBBINS,
Chairman, Board of National Research Fellowships in the Biological Sciences

HONORARY DEGREES CONFERRED AT THE BICENTENNIAL OF THE GEORGE WASHINGTON UNIVERSITY

TWENTY-THREE alumni of the George Washington University received honorary degrees at the Bicentennial Convocation on the evening of February 22. The doctorate of science was conferred on the following:

RAY SMITH BASSLER, M.S. 1903, Ph.D. 1905 (George Washington), A.B. 1902 (Cincinnati). Head curator of geology of the U. S. National Museum and professor of geology in The George Washington University, president of the Paleontological Society of America and vice-president of the Geological Society of America.

ALEXANDER WETMORE, M.S. 1916, Ph.D. 1920 (George Washington), A.B. 1912 (Kansas). Assistant secretary of the Smithsonian Institution in charge of the U. S. National Museum; biologist and author of scientific papers.

DANIEL KERFOOT SHUTE, A.B. 1879, M.D. 1883 (George Washington). Professor emeritus of clinical ophthalmology and formerly professor of anatomy, George Washington; author of articles and texts on anatomy and ophthalmology.

STERLING RUFFIN, M.D. 1890 (George Washington). Professor emeritus of medicine and consulting physician of the hospital of George Washington University.

CHARLES NAPOLEON MOORE, M.S. 1905 (George Washington), A.B. 1903 (Cincinnati), Ph.D. 1908 (Harvard). Professor of mathematics, University of Cincinnati.

JOSEPH FELS RITT, A.B. 1913 (George Washington), Ph.D. 1917 (Columbia). Professor of mathematics, Columbia University.

JOHN HOWARD DELLINGER, A.B. 1908 (George Washington), Ph.D. 1913 (Princeton). Physicist; chief of the Radio Section, U. S. Bureau of Standards since 1918; chief engineer, Federal Radio Commission in 1928.

The degree of doctor of engineering was conferred on:

DAVID ALBERT MOLITOR, B.S. in C.E. 1908, C.E. 1908 (George Washington). Structural engineer; designing engineer on Panama Canal; works connected with Saulte Ste. Marie Falls Canal and the channels through the Great Lakes, and other engineering projects; professor of civil engineering, Cornell University, 1908–11.

PHILANDER BETTS, E.E. 1903, Ph.D. 1914 (George Washington), B.S.-E.E. 1891, M.S. 1895 (Rutgers). Chief engineer, Public Utilities Commission of New Jersey; consulting engineer in electric light and power projects, directing the construction of some of the earliest electric lines.

AWARDS OF THE AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS

THE annual dinner and award of the medals and prizes of the American Institute of Mining and Metallurgical Engineers took place on February 17 at the Commodore Hotel, New York City. The scientific sessions were held at the Engineering Society's Building. Mr. Robert E. Talley, retiring president, delivered the presidential address.

The William Lawrence Saunders Gold Medal, given for distinguished achievement in mining, was presented to Mr. F. W. Bradley, president of the Alaska Juneau Gold Mining Company, "for his skill and success in the creation of new wealth in the face of almost insuperable obstacles" in the operation of a gold mine on the coast of Alaska, which he made "a profitable enterprise although the ore carries less than a dollar per ton in gold."

The James Douglas Gold Medal for achievement in non-ferrous metallurgy was awarded to Professor C. H. Mathewson, of Yale University, for "his scientific contributions to the art of working and annealing non-ferrous metals."

Professor C. T. Eddy, of the Michigan College of Mining and Technology, received the Alfred Nobel Prize of $500 in cash for a "paper of particular merit contributed by a member of any of the four founder engineering societies before the author is thirty years old." Professor Eddy is only twenty-eight years old. His paper was on "Arsenic Elimination in the Refining of Native Copper."

The J. E. Johnson, Jr., award for meritorious researches in iron and steel was given to Mr. Ora E. Clark, of Hamilton, Ohio, who has "developed an exceptional insight into the reactions of an iron blast furnace without the usual aid of a university education, his theoretical training being gained at odd moments through a correspondence course and at night school."

Mr. Howard Scott, of the Westinghouse Company, East Pittsburgh, was the recipient of the Robert Woolston Hunt Prize for his paper on "transformational characteristics of iron-manganese alloys." Mr. Scott has also "developed a number of low-expansion and special-purpose alloys, and has carried on fundamental research in heat-treatment."

Insignia were presented by the retiring president, Mr. Robert E. Talley, to the new members of the Legion of Honor, class of 1882, who had completed fifty years' membership in the institute.

Mr. G. Temple Bridgman, who was the toastmaster, introduced Mr. Scott Turner, president for 1932. The following are the newly elected vice-presidents: Frederick M. Becket, vice-president, Union Carbide and Chemical Company, New York; Paul D. Merica, the International Nickel Company, New York. New directors are: Erle V. Daveler, treasurer, Utah Copper Company; Eugene McAuliffe, president, Union Pacific Coal Company; H. S. Mudd, consulting engineer, Los Angeles; J. B. Umpleby, petroleum engineer, Norman, Oklahoma, and Charles C. Whittier, consulting engineer, Chicago.

THE HAYDEN MEMORIAL GEOLOGICAL AWARD FOR 1932

THE Academy of Natural Sciences of Philadelphia announces that its committee on the Hayden Memorial Geological Award has selected Reginald Aldworth Daly, Sturgis-Hooper professor of geology at Harvard University, as the recipient of the 1932 award.

Professor Daly was selected by the committee in recognition of his outstanding work "in the study of igneous rocks, their genesis and the mechanics of their intrusion into the mountains of the Earth; his glacial-control theory of coral reefs, his work on the eustatic shift of oceanic level and his researches on the constitution of the Earth."

The committee on the Hayden Memorial Geological Award for 1932 consisted of Dr. Charles Schuchert, chairman, Dr. Henry Fairfield Osborn, Dr. Edgar T. Wherry, Dr. Henry A. Pilsbry and Dr. William Berryman Scott.

The Hayden Award was established with the Academy of Natural Sciences of Philadelphia in 1888 by Mrs. Emma W. Hayden, as a memorial to her husband, Dr. Ferdinand V. Hayden, a member of the academy, and director of the U. S. Geological and Geographical Survey in the early days of that organization.

The deed of gift provides that it shall be given "as a reward for the best publication, exploration, discovery or research in the sciences of geology and paleontology, or in such particular branches thereof as may be designated." From 1888 to 1900 the award consisted of a bronze medal and honorarium given annually, but in 1900 a modification of the deed of trust substituted a gold medal to be given every three years, for the previous annual award.

The Hayden Award will be formally presented at the meeting of the Academy of Natural Sciences of Philadelphia on April 19.

SCIENTIFIC NOTES AND NEWS

AT the exercises commemorating the fifty-sixth anniversary of the Johns Hopkins University on February 22, portraits of four past and present faculty members were presented to the university. Dr. Joseph S. Ames, president of the university, presided and Sir Wilmott Lewis, Washington correspondent of the London *Times*, was the principal speaker. Mr. George F. Baker, Jr., New York, presented a portrait of Dr. William H. Wilmer, since 1925 professor of ophthalmology in the school of medicine and head of the Wilmer Ophthalmological Institute of the Johns Hopkins Hospital. The painting is the work of Frank O. Salisbury, London. Dr. William H. Welch, professor emeritus of the history of medicine, presented a portrait of the late Dr. William S. Halsted, first professor of surgery in the school of medicine. Dr. William S. Thayer, professor emeritus of medicine, presented a portrait of Dr. Frederick H. Baetjer, professor of clinical roentgenology. Both of these portraits are the work of Eric Haupt. Dr. William

Seifriz, professor of botany in the University of Pennsylvania, presented a portrait of Dr. Duncan Starr Johnson, professor of botany and director of the Botanical Laboratory and the Botanical Garden.

PROFESSOR R. E. DAVIS and Mr. H. E. Davis, of the University of California, have been awarded the Wason Medal for 1931 of the American Concrete Institute for the most meritorious paper dealing with research in the field of concrete and reinforced concrete. Professor Davis will receive the medal for himself and on behalf of Mr. Davis at a meeting on March 2 of the American Concrete Institute, of which he is a director, in Washington, D. C. At the same meeting he will speak on "The Hoover Dam and its Research Problems."

MR. WILLIS H. CARRIER, retiring president of the American Society of Heating and Ventilating Engineers, has received the first award of the F. Paul Anderson Gold Medal for scientific achievement in his field. Mr. R. A. Harding, of Buffalo, presented the medal at a banquet of the society held recently in Cleveland.

THE 1931 Lamme Medal of the American Institute of Electrical Engineers has been awarded to Mr. Giuseppe Faccioli, Pittsfield, Massachusetts, "for his contributions to the development and standardization of high-voltage oil-filled bushings, capacitors, lightning arresters, and numerous features in high voltage transformers and power transmission." The medal will be presented at the summer convention of the institute, which is to be held in Cleveland, Ohio, from June 20 to 24.

AWARDS of the Geological Society of London have been made as follows: The Wollaston Medal to Professor J. H. L. Vogt, of Trondhjem, Norway, in recognition of his researches on the mineral structure of the earth, and especially his pioneer work in the application of physical chemistry to the origin of igneous rocks and ore-deposits; the Murchison Medal, together with ten guineas from the Murchison Geological Fund, to Professor William George Fearnsides, in recognition of his researches in the Lower Paleozoic rocks of Wales, and other geological investigations; a Lyell Medal, together with £30, from the Lyell Geological Fund, to Mr. Henry Dewey, in recognition of his researches in the geology of the southeastern parts of England, more especially the Quaternary deposits of the London Basin, and a second Lyell Medal, together with £30, from the Lyell Geological Fund, to Dr. Maria Matilda Ogilvie Gordon, in recognition of her researches on the structure of the Western Dolomites.

THE Dawson Williams Memorial Fund, established in 1928 in memory of the former editor of *The British Medical Journal*, which is awarded every two years, or at longer intervals at the discretion of the trustees, in recognition of work done in connection with pediatrics, has been given this year to Sir Robert Jones for his work in connection with the pediatric side of orthopedics. With the consent of the council, the prize will be presented by the president of the British Medical Association on the occasion of his presidential address on July 26.

DR. KARL HERXHEIMER, professor of dermatology at Frankfort, has been awarded the Ehrlich-Weingert Medal by the medical faculty of the university.

THE Mathematical Institute of the University of Moscow has awarded a prize of 750 rubles to L. S. Pontrjagin, member of the institute, for an article entitled "Uber stetige algebraische Körper" which appeared recently in the *Annals of Mathematics*.

DR. C. STUART GAGER, director of the Brooklyn Botanic Garden, has been elected president of the National Institute of Social Sciences, to succeed Mr. William C. Redfield, formerly Secretary of Commerce.

DR. H. H. SHELDON, chairman of the department of physics at the Washington Square College of New York University, was elected president of the American Institute of the City of New York at a meeting held on February 12. Other officers elected were Dr. Otis W. Caldwell, *vice-president;* Dr. William Crocker, *secretary,* and Mr. Alfred Knight, *treasurer.*

MR. H. HOBART PORTER, of New York, president of the American Water Works and Electric Company and chairman of the board of the West Penn Electric Company, has been reelected chairman of the Engineering Foundation. Mr. George W. Fuller, of New York, has been elected first vice-chairman. Dr. C. E. Skinner, president of the American Institute of Electrical Engineers and assistant director of engineering of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pennsylvania, was named second vice-chairman. Mr. George D. Barron, mining engineer, of Rye, N. Y., and Mr. D. Robert Yarnall, manufacturer, of Philadelphia, and vice-president of the American Engineering Council, were elected members of the executive committee.

SIR NORMAN WALKER, Edinburgh, has been elected president of the General Medical Council of Great Britain, succeeding Sir Donald MacAlister, who had been president of the council since 1904 and a member since 1889, a total service of forty-two years.

DR. EMIL ABDERHALDEN has been elected president of the Academy of Sciences at Halle.

DR. JAKOB FRÜH, of Zurich; Professor Samuelowitsch, of Leningrad; Sir Francis Younghusband, of

London, and Dr. Robert Gradmann, of Erlangen, have been elected honorary members of the Geographical Society of Vienna.

THE *Journal* of the American Medical Association reports that Dr. Aldo Castellani, London, has accepted the position of professor of tropical medicine and head of the department at the Louisiana State University Medical Center, New Orleans. His appointment is for the year 1932–1933. Dr. Castellani resigned from a similar position at the School of Medicine of Tulane University in 1929 to devote full time to work in connection with a study of tropical diseases at the Ross Institute of Tropical Medicine, London, of which he was director.

MR. ELLWOOD WILSON, forester of the Laurentide Paper Company of Quebec, has been appointed a member of the faculty of the College of Agriculture of Cornell University in place of Professor Samuel N. Spring, who resigned recently to become dean of the College of Forestry at Syracuse University.

DR. HOWARD E. ENDERS, head of the department of biology in Purdue University and a member of the staff since 1906, has been made dean of the School of Science to succeed the late Dr. Richard B. Moore, who died early last year. Dr. Enders has been acting dean for some months.

DR. ALEXANDER PRIMROSE, dean of the faculty of medicine of the University of Toronto since 1920, retired on December 31. Dr. Primrose first came to the University of Toronto in 1889 as demonstrator in applied anatomy. He is president-elect of the Canadian Medical Association. His successor is Dr. John G. FitzGerald, professor of hygiene and preventive medicine, and director of the Connaught Laboratories.

DR. HUGH S. CUMMING has been appointed for another term of four years surgeon-general of the U. S. Public Health Service. The nomination was confirmed by the Senate on January 28. General Cumming was originally appointed to this position in February, 1920. On completion of his present reappointment he will have served continuously in this office for sixteen years.

DR. HARRY W. SCHOENING, who since September, 1931, has served as acting chief of the pathological division of the Bureau of Animal Industry, has been appointed chief of the division.

DR. E. H. SELLARDS has been appointed director of the Bureau of Economic Geology at Texas. Mrs. F. B. Plummer has been appointed consulting geologist and Joseph Hornberger, Jr., assistant geologist.

PROFESSOR A. O. LEUSCHNER, director of the student astronomical observatory of the University of California, has been elected to the executive committee of the national scientific society, Sigma Xi. He will fill the place made vacant by the election of Dr. Louis B. Wilson, of the Mayo Foundation, to the presidency.

DR. R. C. GIBBS, professor of physics at Cornell University, will be on sabbatical leave during the spring semester.

MR. MATTHEW W. STIRLING, chief of the Bureau of American Ethnology of the Smithsonian Institution, has started on foot to the country inhabited by the Jivaro Indians of Ecuador. Mr. Stirling's last communication came from Mendez, Ecuador, on the border of the Jivaro country, where he had been for the past three weeks. He stated that he was leaving the next day for a seven-day hike down the Paute River after which the expedition plans to work slowly down the Santiago and Maranon rivers to the Amazon and to Iquitos. Then they will strike out again along the Ucayali River, expecting to make their way to Lima. It is expected that Mr. Stirling will return to the United States some time in May.

MR. R. E. PETERSEN, manager of the mechanical division, Research Laboratories, Westinghouse Electric and Manufacturing Company, and Mr. T. S. Fuller, metallurgist, Research Laboratories, General Electric Company, have been appointed members of the Research Committee on Fatigue of Metals of the American Society for Testing Materials, and Mr. Stanton Walker, director, engineering and desearch division, National Sand and Gravel Association, has been appointed a representative on the joint committee on Concrete and Reinforced Concrete. He succeeds Mr. Cloyd M. Chapman, who resigned from this committee.

THE National Land Use Planning Committee, appointed by the Secretary of Agriculture, will consist of fifteen members, five to represent the Association of Land Grant Colleges; five the U. S. Department of Agriculture, three the Department of the Interior, and one each from the Federal Farm Board and the Federal Farm Loan Board. The committee held its first meeting at Washington on February 15. Members of the committee representing the Association of Land Grant Colleges are: Provost A. R. Mann, of Cornell University; President H. A. Morgan, of the University of Tennessee; President H. L. Shantz, of the University of Arizona; Dean C. B. Hutchison, of the University of California, and President F. D. Farrell, of Kansas State College.

PROFESSOR P. DEBYE, head of the Institute for Experimental Physics at the University of Leipzig, is giving a series of lectures on "X-Ray Scattering and Molecular Structure" in the department of physics at the Massachusetts Institute of Technology. Professor

Debye will be Scott lecturer at the University of Cambridge for 1932.

SIR ARTHUR NEWSHOLME, of Birmingham, England, formerly principal medical officer of the local government board of England and Wales, will lecture this spring at Harvard University on preventive medicine.

DR. J. C. MEAKINS, professor of medicine and director of the department of medicine at McGill University, physician in chief to the Royal Victoria Hospital, Montreal, has accepted an invitation to lecture at the Medical School of the University of California in San Francisco. These lectures will open on March 11 and close on April 7.

DR. HENRY K. BENSON, chairman of the Division of Chemistry and Chemical Technology of the National Research Council, delivered the 1932 Alpha Chi Sigma Public Lecture in chemistry at the University of Virginia on February 11. His subject was "Cellulose and Allied Industries."

MR. WILFRED TROTTER took as the subject of the Hunterian oration "The Commemoration of Great Men." The lecture was delivered before the Royal College of Surgeons of England on February 15. A banquet was held in the evening at the college.

MR. J. B. S. HALDANE, Fullerian professor of physiology, is giving a course of five lectures on "Heredity in Man" at the Royal Institution, London.

THE annual meeting of the American Medical Association will be held in New Orleans from May 9 to 13.

THE sixteenth annual meeting of the American College of Physicians will be held at the University of California early in April.

THE summer session of the Hopkins Marine Station, the Marine Biological Laboratory of Stanford University, at Pacific Grove, on the shore of the Bay of Monterey, will open on June 23, lasting until August 31. Courses will be given by Dr. Felix Eugen Fritsch, professor of botany in the University of London, and Dr. Gilbert Morgan Smith, of Stanford University, on the morphology and taxonomy of the algae; by Dr. Cornelis Bernadus van Niel, formerly of Delft, Holland, now of Stanford University, on microbiology, and by Dr. Harold Mestre on plant physiology and on physico-chemical biology. Properly qualified students, interested in individual fields, will be admitted to the laboratories for advanced work and research. Application for accommodation should be made early, as the space in the laboratory available for summer work is limited.

THE College of Puget Sound, Tacoma, Washington, has recently received $150,000 from the estate of Leonard Howarth, and $50,000 from a friend in Portland, Oregon. These gifts have enabled the college to pay the debt on the new science building, and on February 19 it will be dedicated as the Leonard Howarth Hall. The building is 57 by 152 feet, of reinforced concrete faced with brick and has three and one half stories. It houses the departments of biology, chemistry, domestic science, geology and physics. These gifts make it possible for the college to receive $135,000 from the General Education Board of the Rockefeller Foundation, completing a gift of $250,000. The college endowment is now about $1,250,000. Its plant, valued at $700,000, is entirely free from debt.

THE Mineralogical Society of America is compiling a list of mineral collections, public and private, in the United States and Canada, the intention being to publish this information in the form of a regional directory in *The American Mineralogist*. Curators of collections and mineral collectors are asked to send their names and addresses, and some data regarding the nature of their collection, their origin, and when they can be seen by visitors. The society would also welcome information regarding other collections known to the correspondents, which they consider should be included in the directory. Since the success of the survey being made will very largely depend upon such cooperation, an earnest appeal is made for full, complete and prompt replies. Correspondence should be addressed to Samuel G. Gordon, Academy of Natural Sciences of Philadelphia, Logan Square, Philadelphia, Pennsylvania.

The Museum Journal reports that the first new unit of the east wing of the California Academy of Sciences has been completed and the departments of entomology and fishes and the administrative offices have moved to their new quarters. The habitat groups in the Simson African Mammal Hall are now being installed under the direction of Frank Tose, chief of exhibits, with the assistance of John Adams and Jenness Richardson, mammal taxidermist; Stuart Rowley, Marietta Edwards and Richard Cayzer, installation and accessories; Cecil Tose and William Hayden, assistant preparators, and J. M. Barclay, general assistant. Hanson Puthuff, of Los Angeles, California, is expected to paint the first backgrounds. The opening of the hall to the public is planned for December, 1932. The main hall contains space for twenty-four groups, all of which will be displayed under artificial light.

SCIENTIFIC work, according to a summary given out by Science Service, in the Bureau of Geological Survey, will be curtailed in 1932–33, as a result of action first by the Budget Bureau and second by the House Committee on Appropriations. For the entire bureau

there is a decrease of almost $1,500,000 in appropriations, compared to 1931–32. For some years the Geological Survey has been engaged in making a topographic map of the United States. It is expected that the Congress will follow recommendations of the committee in cutting this work down by at least $100,000 more than suggested by the budget, which was a $164,000 decrease. Geologic surveys, for which $400,000 was asked (the same as the amount appropriated for 1931 and 1932) will probably be cut $50,000; likewise fundamental research in geologic science, for which $100,000 was asked. Volcanologic surveys will probably be cut down from $35,000 in 1931–32 to $21,000. The main volcanologic observatory of the United States is in the Hawaiian Islands on the great volcano of Kilauea. Investigation of the mineral resources of Alaska, an item for which it was hoped there might be $84,500, the same as in 1932, was reduced by $17,000. Gaging streams and determining water supply of the United States has been cut $119,500. It had been estimated that $719,500 would be required. Other items suffering cuts are the classification of lands, the printing of geologic maps, and investigations of minerals on public lands and naval petroleum reserves.

In order to achieve a broader representation of sportsmen and conservationists upon the Advisory Board, Migratory Bird Treaty Act, and to obtain a large measure of local cooperation in the problems of conservation and enforcement, a reorganization of the board is being planned by Secretary of Agriculture Hyde. As a means of securing more direct regional representation on this board, the states have been tentatively divided into ten groups. These groups are so arranged as to give consideration to such matters as relative density of population and dissimilarity of conditions affecting migratory birds, as well as the various interests of those who are concerned in their welfare. A majority of the members of the board will be selected from these groups in cooperation with and upon the recommendation of the state conservation officials. The advisory board is organized for the purpose of assisting the federal authorities in a solution of regulatory problems in connection with the federal administration of the migratory bird resource. When constituted, it will be requested to study and recommend definite policies upon all questions affecting the interest of the sportsmen and conservationists of the United States and falling under the jurisdiction of the Biological Survey, U. S. Department of Agriculture. Such subjects as length of seasons, bag limits, shooting restrictions, zoning, measures for increasing the supply of both upland game birds and water fowl and measures for conserving the existing supply will be submitted to it.

DISCUSSION

THE PROCESS OF GIORDANO BRUNO

In his presidential address to the Astronomical Section of the American Association for the Advancement of Science published in SCIENCE of January 8, 1932, President D. W. Morehouse says: "Suggestions were heard on every side that such views should be forcibly repressed, and some of its advocates, for example, Bruno, were condemned to death and burned at the stake in 1600. As history records, the second martyr of the Jesuits was harassed and persecuted solely for his adherence to the Copernican system." This statement is erroneous.[1] The external data of Bruno's life are the following:

Bruno was born in 1548 in Nola, a small town near Naples, entered the Dominican order at the age of 14 or 15 years, and left the order in 1576, travelled then extensively in Italy, France, Switzerland, England and Germany. He returned to Italy, was accused in Venice, arrested and tried there in 1592 before the Inquisition. In 1593 he was extradited to Rome, where his process lasted until 1600, in which year he was condemned and burned at the stake. The question now arises as to what the reasons for this condemnation were.

The documents of the Venetian process were first published by Berti. A more recent book is by Father Luigi Previti, S.J., "Giordano Bruno," Prato, 1887.[2] The documents of the Venetian process contain first the denunciation by Giovanni Mocenigo on the grounds of heresies concerning the Trinity, the sacraments, the transmigration of souls, the existence of an infinite number of worlds and the eternity of the world, besides teaching conjuration (I am not giving the complete list). After a number of purely formal documents we find then a complete record of the interrogation of Bruno. This record gives the impression of stenographic accuracy; the questions of the court apparently being written down beforehand in grammatically correct style, while the answers of the accused show all the characteristics and repetitions of extemporaneous speech. One can judge the points

[1] Sir James Jeans says also in his book, "The Universe Around Us," that Bruno was condemned because of his advocacy of the Copernican theory.

[2] I am indebted to Father Gerald Walsh, professor of history at Woodstock College, for drawing my attention to this book, and putting it at my disposal.

which were used in the indictment from the questions which were asked. They concern points in the dogma of the Trinity, incarnation and the sacraments. He was questioned whether he had said that Christ and the Apostles were magicians (or sorcerers?), whether he believed in the migration of souls. He was asked, and confessed, that he had taught that fornication was a small sin and had condemned the church in forbidding it. He ("the martyr of science") was accused of defending conjuration. Furthermore, he was questioned about his associations in Geneva and England (where he had written a book "Spaccio della Bestia triofante"—"Expulsion of the Triumphant Beast"—interpreted as aimed at the Church). In the whole interrogation there are only three places which are even slightly bearing on the question of natural science. At the beginning of the interrogation, upon being asked whether he confesses errors, he himself said that he had taught the existence of an infinite number of worlds and that the earth was one of the stars. But this point was not taken up in the questioning, and is not contained in the summing-up of his errors which is given by the court (Previti, p. 351).

The second point was on determinism and was contained in the question whether he had denied Providence (p. 357). Finally, he had at the beginning handed over a list of all his published books. He was asked why this did not contain the book "cena delle ceneri." He answered that this book, published in England, treated of the motion of the earth. No further mention is made of its contents—they had not been questioned (p. 358). Nowhere is there any mention of the Copernican theory in the whole process. In the request for extradition which the Papal Nuncio addressed to Venice, Bruno is accused of his associations in Geneva, France and England, and of heresies concerning the dogma of the incarnation and of the Trinity. No mention whatsoever is made of any physical theory.[3]

The acts of the Roman process are not published, except a few purely formal ones, but as the punishment is one reserved for relapsed heretics one must assume that it went over the same ground as the process of Venice. There do exist documents to show that here too there was no mention of Copernicus' theory. There exists a letter of Gaspare Scioppio (Kaspar Schopp) to Conrad Rittershaus. Schopp[4] was an eye witness of the execution and says that he had heard the sentence proclaimed. According to him, Bruno was condemned because of heresies against the sacraments, the incarnation, because of teaching the transmigration of souls, the innumerability and eternity of the worlds, because of his denial of the divinity of Christ and the statement that Christ and the Apostles were magicians. It is true that the authenticity of this letter is denied by some; however, in a book published eleven years later, he says that Bruno was executed because he did not want to abjure his pagan acceptance of "portenta et monstra" (apparitions), and his statements against Christ and the Apostles (Previti, p. 211).

However, there is another argument which seems to me quite independent of the documents and quite convincing that the condemnation of Bruno had nothing to do with Copernicus' theory, and that is a simple comparison of the dates. Bruno was tried in 1592 and executed in 1600. In 1611 Galileo came triumphantly to Rome, and it was not until 1615 that proceedings against him were begun. It is quite clear that if there had already been proceedings on account of this theory, and if Bruno had been condemned to the stake in 1600 for it, the adversaries which Galileo had before 1615 would have behaved quite differently and would not have failed to point out that he was defending the theory on which the Inquisition had already acted. Galileo himself, of course, would also have behaved quite differently in this case.

As to President Morehouse's remark, "the second martyr of the Jesuits," it might be said that on the Roman tribunal of sixteen judges there were 12 seculars, 3 Dominicans (Bruno's own order) 1 other monk and 1 (!) Jesuit.

Bruno might perhaps be called a martyr to Pantheism, to Buddhism, to Unitarianism, but surely not to science.

K. F. HERZFELD

THE JOHNS HOPKINS UNIVERSITY

A SMALL INSECT WHICH STINGS SEVERELY

IN November, 1925, a minute black hymenopterous insect, scientifically known as *Epyris californicus* (Ashmead), was first sent to the University of California by a farmer at Clarksburg, Yolo County, California, with the statement that it had severely stung a child several times and was the cause of severe pain and considerable inflammation. Due to the fact that the insect in question is barely over 5 mm. in length, the idea of its being so formidable was doubted. Specimens forwarded to the Bureau of Entomology were determined as the above by S. A. Rohwer, who stated that they were the only other ones seen up to that time which agreed with the original types.[1] Although informed that probably

[3] It will be found that this presentation agrees with the one in T. L. MacIntyre, Giordano Bruno, London, 1903, although this author is very favorable to Bruno.

[4] This letter can be found in Previti's book on page 440.

[1] W. H. Ashmead described the species as *Mesitius californicus* from several specimens taken in California

me other insect was responsible for the injuries the child, the farmer insisted that he had sent e real culprit.

In October, 1928, more specimens of the same in-et were received from Davis, California, with a nilar claim that they were stinging children, and rticularly a small infant in its crib. To make sure the exact identification, specimens were again sent the Bureau of Entomology and determined as the ove by A. B. Gahan. By this time I was beginning suspect that this small parasite was assuming a w rôle, but there was no way to prove or disprove e suspicions. Additional information concerning is interesting insect was received on October 16, 30, from Frank B. Hopkins, a teacher of biology the Esparto Union High School, Esparto, Califor-a, who wrote as follows: "I am sending a box con-ining a little vial in which are four or five little ymenoptera. Will you please tell me what you ink they are? They were handed to me by a lady ere, who is frequently stung by them so badly they ake her ill. The first time she was stung (she was one), she went into a heart attack and nearly died. he managed to call help, however, and when the hysician came he administered strychnine. She con-inues to keep the drug by her, but usually applies lcohol to allay the sting. The house is surrounded y large walnut and Mission fig trees. This is the nly case of the kind in the community of which I an learn."

A few days later another case was reported at Woodland, California, by an attending physician, who submitted specimens to Dr. Tracy I. Storer, of the University of California at Davis, which later ame into my hands for verification.

All these cases were reported from a comparatively small area in Yolo County and to date no such reports have come from any other county in California, nor have I noted similar records from any other tate or country.

The evidence at hand indicates beyond doubt that *Epyris californicus* stings humans, both young and dult; that it is able to inflict considerable pain and nflammation; that its activities are at present quite restricted as to localities; and that its attacks are sporadic and uncommon. Concerning the life history and habits of this particular species, beyond its propensity for stinging, absolutely nothing is known. According to Imms,[2] "*Epyris* stings Tenebrionid larvae and lays a single egg on each." In California Tenebrionid beetles are abundant and perhaps furnish the natural food supply for this hymenopterous parasite.

E. O. Essig

University of California

in his Monograph of the North American Proctotrypidae, Bul. 45, U. S. Nat. Mus., pp. 65–66, 1893. It is now placed in the family Bethylidae, superfamily Proctotrupoidea.

[2] A. D. Imms, "A General Text-book of Entomology" (Dutton, N. Y., 1930), ed. 2, p. 574.

HAMIVOROUS FISH

In the November 20, 1931, issue of Science, Mr. C. T. Hurst directed attention (on page 515) to "a quite curious case of gastric erosion of a fish hook that had been swallowed by a fish."

Upon its appearance, I showed this fish story to Dr. Charles Reitell, the well-known ichthyophile and the author of "Let's Go Fishing." He said immediately: "Any one who fishes for pickerel as much as I do finds it quite a common experience to discover old hooks in the anatomy of this fish. Because of his sharp teeth, he often saws off the line or gut. More than once I have found trebled hooks deeply imbedded in the throat of a pickerel which, with the very slightest pressure, were crushed."

The experience of Dr. Reitell, then, confirms in general Mr. Hurst's report.

W. A. Hamor

Mellon Institute

RELATIONS BETWEEN FUNDAMENTAL PHYSICAL CONSTANTS

A numerical relation has been found between the fundamental physical constants shown below and the velocity of light. This relationship is of such a nature that the constants can be calculated from a single equation $1/2\pi c = C^{12}$ and the power of the velocity of light shown, provided the decimal point is ignored. A complete solution of the relation given, enabling the decimal point to be properly placed, has not yet been found. It is, however, not possible that any merely accidental agreement could produce the numerical agreement shown below. The facts concerned will be presented in a more technical paper.

Calculation of Fundamental Physical Constants

		Observed	Calculated
C	C	$(2.99796 \pm 0.00004) \times 10^{10}$	2.99960
C^2	m_o	$(8.994 \pm 0.014) \times 10^{-28}$	8.99761
C^6	1/k	$(7.294 \pm 0.0074) \times 10^{15}$	7.28415
C^8	h	$(6.547 \pm 0.008) \times 10^{-27}$	6.55402
C^{14}	ε	$(4.770 \pm 0.005) \times 10^{-10}$	4.77401
C^{24}	m_p	$(1.6610 \pm 0.0017) \times 10^{-24}$	1.66014
C^{26}	$\frac{1}{G}$	$(1.5006 \pm 0.0005) \times 10^{7}$	1.49373

π = Geometrical Constant; C = Velocity of light; m_o = Mass of electron; m_p = Mass of proton; h = Planck's Constant; ε = Electronic charge; G = Gravitation Constant; k = Boltzmann Constant.

J. E. Mills

University of South Carolina

January 26, 1932

SOCIETIES AND ACADEMIES

THE NORTHWEST SCIENTIFIC ASSOCIATION

THE members of the Northwest Scientific Association assembled for their eighth annual meeting at Spokane, Washington, on December 29 and 30, 1931. Notwithstanding the anticipation that the attendance might be reduced, over 170 members of the association were present, in addition to numerous guests. This constitutes the largest attendance yet recorded at any annual meeting, being an increase of approximately 18 per cent. over that of the largest previous meeting.

The meetings were presided over by President Ernest O. Holland, of the State College of Washington, president of the organization for the year 1931. At the opening meeting, on December 29, President Homer L. Shantz, of the University of Arizona, was to deliver an address on the subject, "The Vegetation of the United States and its Relation to Agriculture." Unfortunately, President Shantz was unable to leave Arizona because of a special session of the legislature. In his absence his place was filled by Dr. E. F. Gaines, of the State College of Washington. Dr. Gaines related impressions of Russian scientists and the Russian experiment stations, gathered during a year of study and travel in Europe in 1930–31. On the same day a broadcast through the courtesy of the National Broadcasting System was to have been given under the auspices of the association, the speaker being Dr. George D. Louderback, of the department of geology of the University of California. Due, however, to a severe storm, wire connections were suspended and the broadcast was cancelled.

In addition to the general sessions, section meetings were held by the following sections: Botany-Zoology, Chemistry-Physics, Education-Psychology, Engineering, Forestry, Geology-Geography, Medicine-Surgery and Social Science. On the morning of December 30 a joint session of several of the sections was held, the symposium topic being, "Climate and its Relation to Science in the Northwest."

At the general meeting on December 30 the association passed resolutions commemorating the service to science of Dr. W. J. Spillman, a former member of the faculty of the State College of Washington, later a nationally known figure in the field of agricultural economics, and of Dr. B. L. Steele, a member of the association and of the faculty of the State College of Washington at the time of his death.

A resolution was also passed requesting that the members of the agricultural committees from the Northwest in the House and Senate direct their attention to the menace to agriculture arising from soil erosion.

At a council meeting of the association the officers and councilors decided to make the coming meeting of the Pacific Division of the American Association for the Advancement of Science, to be held at Pullman, Washington, from June 15 to 18, a special meeting of the Northwest Scientific Association and to cooperate in every way possible to make the meeting successful. To this end President Holland appointed a contact committee from the association consisting of the following members: C. C. Todd, *chairman*, J. W. Hungate, H. B. Barss, John W. Finch, L. K. Armstrong, Charles H. Clapp, F. A. Thomson, Alfred Atkinson, I. N. Madsen and R. E. McConnell. The secretary reported that the association is now connected with the American Association for the Advancement of Science, having affiliated as an academy in April, 1931.

The following officers will serve for 1932:

President: Ivan C. Crawford, dean of the school of engineering of the University of Idaho, Moscow, Idaho.

Vice-President: T. C. Spaulding, dean of the School of Forestry of the State University, Missoula, Montana.

Secretary-Treasurer: J. W. Hungate, State Normal School, Cheney, Washington.

Councilors: E. E. Hubert, School of Forestry, University of Idaho, Moscow, Idaho; Charles H. Clapp, State University, Missoula, Montana; H. N. Putnam, U. S. Blister Rust Service, Spokane, Washington; E. F. Gaines, Washington State College, Pullman, Washington; and G. D. Schallenberger, State University, Missoula, Montana.

Trustees: F. A. Thomson, School of Mines, Butte, Montana; Thomas Large, Lewis and Clark High School, Spokane, Washington, and L. K. Armstrong, 704 Peyton Building, Spokane, Washington.

E. E. Hubert, editor of *Northwest Science*, the official publication of the association, was reappointed for the year 1932. The assistant editor will be A. L. Anderson, of the department of geology, University of Idaho, Moscow, Idaho.

The following were elected as chairmen of the various sections:

Botany-Zoology, H. B. Stough, University of Idaho, Moscow, Idaho; *Chemistry-Physics*, G. L. Luke, University of Idaho, Moscow, Idaho; *Education*, C. I. Erickson, State College, Pullman, Washington; *Engineering*, H. E. Langdon, State College, Pullman, Washington; *Forestry*, S. N. Wyckoff, U. S. Blister Rust Control, Spokane, Washington; *Geology-Geography*, John W. Finch, University of Idaho, Moscow, Idaho; *Medicine-Surgery*, Dr.

D. Hartin, Old National Bank Building, Spokane, Washington; *Social Science*, T. S. Kerr, University of Idaho, Moscow, Idaho.

J. W. HUNGATE,
Secretary-Treasurer, Northwest Scientific Association.

FOURTH ROUND TABLE OF CATHOLIC SCIENTISTS HELD IN NEW ORLEANS

FORTY-ONE priests, nuns and lay delegates, representing twenty-four Catholic educational institutions in the United States and Canada, attended the round table for Catholic scientists and teachers of science which was held in New Orleans, on December 28, 1931. The meeting was held at Loyola University, following a luncheon at which the president and faculty of the university acted as hosts.

The round table is an informal group of research workers and teachers which originated at the American Association meetings in New York City in 1928. It started with only six members, but each succeeding year has interested a steadily increasing number in attending the A. A. A. S. meetings. Encouragement of productive scholarship, as distinct from the purely absorptive, by Catholics in the field of natural science is the main object of the round table. Its sessions are held during the association meetings, since its members feel that, inasmuch as science in general and scientific research in particular are neutral as regards religious belief, the formation of anything that savored of a separate Catholic body would be superfluous and, given the hazard of misinterpretation of its aims by Catholics and non-Catholics alike, apt to do more harm than good.

In order to further its main objective the round table has sponsored discussion groups, membership in the A. A. A. S. and its associated societies, shorter teaching hours and more research equipment for members of science faculties, and a continued program for encouraging worth-while students to make science teaching and research a life career in preference to other overcrowded professions.

More than three hundred names, including those of several bishops and college officials, listed in the membership of the round table, testify to a healthy interest in its activities. Reports of past sessions will be freely supplied by the writer, the secretary for the present year.

A. M. KEEFE

ST. NORBERT COLLEGE,
WEST DE PERE, WISCONSIN

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A ROTARY MYOGRAPH

REQUIRING several myographs for student laboratory use, the simple apparatus as sketched was designed and proved satisfactory in use.

The equipment shown presents several advantages over those listed in various catalogs at prices of $200 and more. The rotary myograph as pictured requires no casting patterns and can be made from material usually found in physiological or biological laboratories. Other advantages besides the low cost are: The writing surface is nearly twice as long and is fully twice as wide as those found on the expensive machines. The principal wearing surface has ball bearings in place of friction rods. The weight of the entire machine is about one tenth and the storage space required about one fourth of the heavier machines. The noise of operation is no greater and the speed of the drum does not vary with uniform spring tensions. The speed of the writing surface may be adjusted over a wider range, while speeds of one thousandth of a second per centimeter have been attained; this is at least ten times that required for the usual student use in studies on speed of the nerve impulse, determination of latent period, stimuli summation, refractory period studies, reaction time studies and others.

The drum can be removed without releasing catches, and the ordinary kymograph paper may be used. Any laboratory using kymographs may make the drums of these serve double duty without having to invest funds in expensive equipment.

MATERIAL AND CONSTRUCTION

Ordinary aluminum drums of the Harvard type were used, although others would serve as well. Center rod ringstands may be employed for the base and drum axis. Other material, such as brass plate, spring wire, machine screws and nuts, fiber sheets and cheap quilt frame clamps, are usually to be found in the stock of most schools or can be readily obtained.

The base plate may be a center support ringstand base or heavy iron plate, the rod which serves as the drum axis must be a close but free fit. Cased ball bearings obtainable at cycle shops, placed as shown, reduce friction and make for smooth action, although these are not essential to a good working assembly. The set shows a support rod for the switches, but these can as well be placed on adjacent ringstands.

A fairly strong spiral spring is essential for the driving unit; these may be obtained from old bedsprings or from heavy door-springs. The —| shaped spring stop may be made of brass or may be a short bolt through the base plate. The collar with wing nut

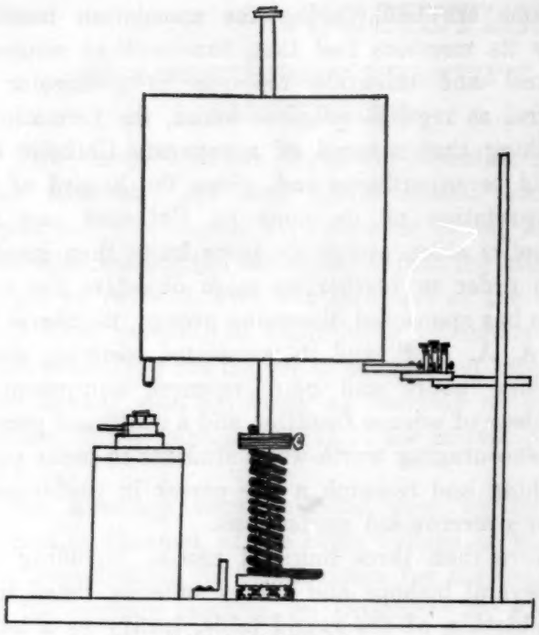


FIG. 1

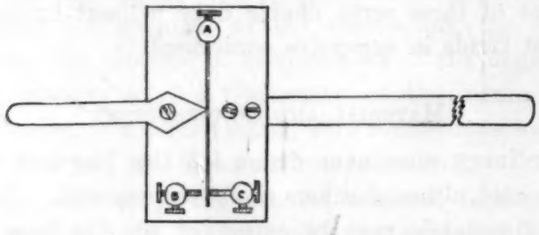
makes the upper end of the spring fast to the hollow drum support and allows for spring tension adjustments.

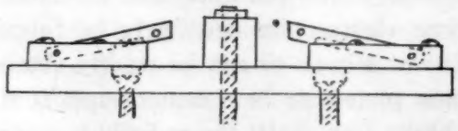
The switch assembly is self-explanatory, and either spring brass or steel may be used for the vane. Contact points may be platinized if desired.

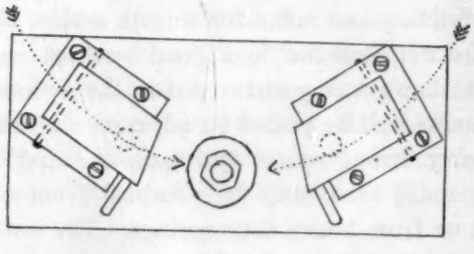
The most difficult part of the assembly to make is the drum catch and release. Figs. 3 and 4 give a top and side view of this in proportions. One fourth inch brass plate is used to cut out the U-shaped retainers for the catches. These catches are normally held up by spiral brass springs placed over the set in bolt heads, the shanks of which run to the base plate. Quarter inch brass plate is used to mount the catches and central bumper post on, the entire catch and release assembly is mounted on a wooden block which is firmly attached to the base plate by the three bolts. The center bolt is fitted with a rubber stopper to reduce noise and prevent backlash.

The catch and trip pin on the drum is a brass machine screw, this is covered by fiber tubing, except at the wearing edge. The dotted arrow in Fig. 3 shows the path of the trip pin. By proper placing of the switches this trip pin will cause either make or break stimuli to occur. Since the switches function either right side up or inverted stimuli may be placed as close together as wanted or even be made simultaneous by placing one switch over the other.

In use the spring tension is adjusted to give a drum speed of approximately one centimeter per hundredth of a second. The drum pin is held by the catch and release is obtained by depression of the small pin projecting from the catch. If the base plate is not heavy enough to prevent jump of the assembly in use, a small quilt frame clamp such as found in dime stores may be used to fix the assembly to a desk top. Set screws must be employed to firmly fix the drum to its hollow support rod. All kymograph drums do not have these, but they are easily attached.







FIGS. 2, 3 and 4

SEWARD E. OWEN

DEPARTMENT OF PHARMACOLOGY
AND PHYSIOLOGY,
UNIVERSITY OF UTAH

MULTIPLE LABORATORY INCUBATOR FOR THE BIOLOGICAL STUDY OF CHICK EMBRYO

IN former publications in this journal,[1] and elsewhere,[2,3] I have emphasized that the accurate control of the most important physical factors, such as temperature, humidity and composition of air, is absolutely indispensable in the experimental incubation of hen's eggs. The importance of such control in all physiological and physicochemical studies of the embryo is obvious when daily observations have to be made on a small number of various individuals.

The laboratory incubator previously described[1,2,3] had already given excellent service by its accuracy in the control of the various physical factors and by its adaptability to a wide range of experimentation. With this incubator we were enabled to obtain very

[1] A. L. Romanoff, SCIENCE, 69: 197–198, 1929.
[2] A. L. Romanoff, *Cornell Univ. Agr. Expt. Sta. Memoir*, 132: 1–27, 1930.
[3] A. L. Romanoff, *Jour. Morph. and Physiol.*, 50: 517–525, 1930.

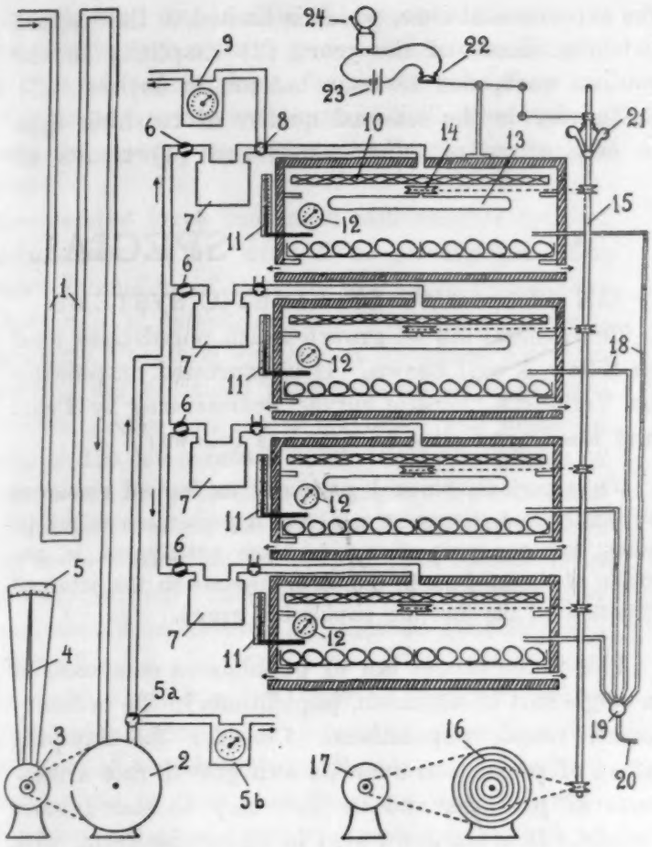
uniform and conclusive data on some phases of the embryonic growth,[4] metabolism and mortality, and also on the physicochemical changes in the egg contents under standardized,[5,6] or "normal" and adverse conditions of incubation: humidity,[2,7] composition of air,[3,8] and temperature.[9]

However, our experience showed that the above-mentioned incubator, being of a single-compartment only, is not efficient enough. Only a few experiments can be carried on during the natural hatching time, which is limited to about six months, that is, approximately from December to July. Secondly, when the results of several experiments are to be used for comparison, this incubator does not eliminate seasonal variation in the hatching quality of eggs; but it is a well-known fact that the average hatching of eggs varies throughout the season.

Therefore, in order to eliminate the influence of the season on the hatching quality of eggs and also to increase the efficiency of experimental work, we soon saw the need of a multiple, or of a several-compartment laboratory incubator, to carry on several experiments simultaneously. A commercial sectional incubator (vertical type, four compartments) was completely remodeled and all necessary special equipment was installed,[10] as shown on the accompanying diagram.

Each compartment (capacity 152 eggs) of the new multiple incubator is equipped independently with electric devices which allow wide range in the control of temperature, humidity, supply of fresh air, rate of mixing of air and turning of eggs. Beside that, a special provision is made for sampling and transferring of air to the laboratory for analyses. Accuracy in the control of temperature and humidity has been attained within an average, $\pm$ 0.2° C. and $\pm$ 1.0 per cent. relative humidity.

When the incubator is in operation, outdoor fresh air, regardless of atmospheric conditions, may be brought continually through the long pipe (1), in which it is heated to room temperature, by means of the blower (2), driven by the variable-speed motor (3). The speed of the motor is regulated by the control lever (4), a point of which is laid against the scale (5). The total rate of air flow is measured at



the three-way valve (5a) by the gas meter (5b); then air is distributed at will by means of the valves (6), conditioned in respect to humidity in the humidifiers (7), and the actual amount of it in each compartment is determined at the three-way valves (8) by the gas meter (9). Indrawn air strikes the electric heater (10), which is controlled by a thermostat with mercury switch. The temperature is recorded by the right-angle thermometers (11) graduated to 0.2° C., and the humidity recorded by the precision hair hygrometers (12). Air in each compartment is evenly distributed over the hatching eggs by the air mixers (13), which have the pulleys (14) connected with the shaft (15) and, through the countershaft (16), to the low-speed electric motor (17). At any time samples of air may be drawn through the sampling tubes (18) and the selective valve (19) to the outlet tube (20) leading to a laboratory analysis apparatus. In order to prevent any accident from an electric power shut-off or disorder in circulation or mixing of air, special electric alarm systems are connected with the living quarters of the operator. The circulation of air is under the control of a system similar to that previously described;[2] but the mixing of air is controlled by the governor (21) connected with the mercury switch (22), the battery (23) and the electric bell (24).

The efficiency of the above-described laboratory incubator, as compared with the old incubator, is obvious. It provides: (1) greater accomplishment in

[4] A. L. Romanoff, SCIENCE, 60: 484, 1929.
[5] A. L. Romanoff, *Alabama Polytech. Inst. Bul.*, 25: 45–49. (Poultry Sci. Assn. Proc., 21: 45–49, 1929) 1930.
[6] A. L. Romanoff and A. J. Romanoff, *Biol. Bul.*, 57: 300–306, 1929.
[7] A. L. Romanoff, *Jour. Exp. Zool.*, 54: 343–348, 1929.
[8] A. L. Romanoff and A. J. Romanoff, *Jour. Exp. Zool.*, 56: 451–457, 1930.
[9] The data from two years of experimental work are ready for publication.
[10] The assembling of this laboratory incubator was made possible in part through the assistance of the Smith Incubator Company Fellowship Fund.

the experimental time, which is limited to the natural hatching season of the year; (2) simplicity in the routine work, due to many automatic devices; (3) uniformity in the seasonal quality of hatching eggs in each group of experiments; and (4) results of several experiments suitable for comparison, particularly in the study of the effect of various environmental factors on the developing embryo.

ALEXIS L. ROMANOFF

CORNELL UNIVERSITY

SPECIAL ARTICLES

ON THE LAWS OF KINETIC SYSTEMS

THE general law of growth which populations tend to follow is well known. It is expressed graphically by Verhulst's "logistic curve," rediscovered by Pearl and Reed,[1] and may be stated as follows:

> While periodic renewal maintains its limited resources in matter and energy at one level, a population so multiplies that the proportional increase anticipated in absence of checks fails in the same measure as the attained fraction of the limiting population grows.

This is the master law of populations composed of a single sort of organism, populations in the ordinary sense, *simple* populations. Consider the damping effect of population upon its own growth-rate a measure of pressure, and the law may be stated more briefly. It is set down next in its concise form, with four additional laws derivable from it by inspection.

General law of simple populations: While periodic renewal maintains its limited resources at a constant level, the pressure in a population varies as the attained fraction of its limit.

Secondary laws: (1) When in a population the average individual energy is constant, pressure varies inversely as the volume occupied.

(2) In a mixed population each component exerts the same pressure as if it alone occupied the whole volume, and the total equals the sum of the several partial pressures.

(3) If the average energy of their units be the same, equal volumes of two populations under the same pressure contain the same number of individuals.

(4) At constant pressure the volume occupied by a population, and at constant volume the pressure in a population, varies as the average individual energy.

Here it must be stated that in applying the secondary laws of populations, or in testing their applicability to empirical data, one must always measure volume in appropriate units. In working with flies, for example, a pint bottle doubly charged with banana-agar may not be considered an experimental "universe" of twice the volume of a half-pint singly charged. The true two-unit universe is one composed of two half-pint bottles with a single charge each.

In the pint bottle doubly charged, the whole method of yeast culture, for use of the adult *Drosophila* population it largely supports, is changed by altering the relation between surface and volume of the substratum on which the yeast is grown. The result is just such as a revolutionary change in agricultural methods would entail in the growth of a human population. Or, again, the transfer of a fly population from two communicating half-pint bottles normally charged to a pint bottle doubly charged, if all the details of Pearl's culture method were followed throughout, should induce just such a change in the curve of population growth as occurred when Germany and Japan turned from agriculture to industry in the nineteenth century.[2] A change opposite in sign should probably follow the transfer of a similar population to four gill-bottles connected with one another and provided with half the standard charge each.

The situation may be seen more clearly if approached from another direction. Space, from the standpoint of the kinetic theory of gases, does not differ qualitatively from point to point. But from that of populations it has structure virtually imposed upon it; if not by the mode of distribution of sources of matter and energy, then by the distribution of opportunity for the disposition of population wastes. Thus to add unit to unit of volume, when dealing with simple populations, it is necessary to add to one structured system another quite like it; or, in effect, to measure volume in terms of the unit universe, be it what it may, rather than in standard cubic centimeters or inches.

Another point requires passing mention: The pressure in a population varies with the attained fraction of its limit; and the limit is fixed by the ratio between available maximum in some critical factor and individual need. But need and expenditure, intake and outgo, are merely the debit and credit sides of the organism's ledger account with energy. Hence the legitimate substitution of the term "individual energy" for "individual need" in the secondary laws of simple populations to which we now return.

These laws relate to one another four terms—pressure, volume, number and average individual energy. But these are the terms which appear in the gas laws, and the relations said to exist between them are precisely the same in the two cases. We must therefore

[1] *Proc. Nat. Acad. Sci.*, vi, pp. 275–288, 1920.

[2] Raymond Pearl, "Biology of Population Growth," pp. 19–21, 1925.

nt the secondary laws of simple populations homo-ues, not distant analogues,[3] of the gas laws: and, the same reasoning as we pass from empirical laws a kinetic theory of gases, we must pass from their n empirical laws to a kinetic theory of simple popu-ions.

It has been suggested earlier[4] that in great natural oups of organisms genera grow according to one which varies from group to group only as growth ording to the logistic curve varies from population population. This law of generic growth, law of fferentiation, or law of evolution, is the master law second-order populations. It may be expressed by graph of which the ordinates in order are propor-nal to the sums, from the second onward, of the mologous terms of an infinite series of infinite de-nding geometric progressions of equal sum, whose mmon ratios lie between 0 and 1.0, with normal quency distribution about the mean.

In this statement the veneer of mathematical rases overlies sound biological and typically Dar-nian construction. Aside from the idea that sur-val values fluctuate according to the law of chance, thing is implied beyond the fact that variation, heritance and natural selection are factors in evolu-n. But where species beget species by a process generation in which like tends to produce like, a ndency for types to increase in geometrical pro-ession will appear. And where there is struggle r place, a limit to the number of types which may produced is indicated.

The joint effect of the two factors, tendency to ometric increase and the damping effect of pressure, mposed on the terms it is by the fixed limit, is to make rowth in populations of organisms follow the logistic rve. But where the law of the logistic holds, lesser ws—homologues of the gas laws—hold also; and here these hold we deal with a kinetic system. Species-populations, or second-order populations, are herefore kinetic systems.

If at this point the soundness of the conclusion ems to depend wholly upon the correctness of the remises, the reader should consider these facts: nalysis of the data of taxonomy and distribution ows that species of large genera occupy upon the verage large areas, while those of small genera milarly occupy small. This is clear evidence that scendant species inherit ancestral ability, more rrectly the bases of ancestral ability. Jaccard's w, that the number of species per genus in a region ries with the ruggedness of the topography, shows as clearly that the number of species which may be produced in any natural group is limited. Finally, the data of paleontology, fragmentary as they are, as far as they go are consistent with the idea that increase in species-populations follows the logistic curve.

Besides the three mentioned still another type of kinetic system is the "excited" or glowing gas. The relative intensities of the lines in its spectrum change with changes in its temperature. The change proceeds regularly. The total number of its atoms active in absorbing (or emitting) a subordinate series of lines increases, passes through a maximum and decreases again, as the temperature is raised..[5] The effects of pressure are as general and regular. With increase all lines shift toward the red, the shift in each series being more marked on the part of lines appearing at high temperature.[6] Intensities, too, according to Miss Payne, should be affected by pressure generally and regularly.[7]

In short, then, a normal and an "excited" gas, a simple and a second-order population seem four distinct types of kinetic system. Because of the activity of their units, be they what they may, and their random action one upon another, certain of the laws of the four are alike in principle. This group of laws, common to kinetic systems as here understood, are the gas laws and their homologues.

But, besides the peculiarities they share, the units of these several systems have their distinctive attributes. One is neither variable nor capable of reproduction; another is capable of variation but incapable of reproduction. Still another is (by definition) capable of reproduction but no variation, and the last both reproduces and varies genetically.

It is to these differences we must ascribe the fact that the master laws of the several systems are different. That of the first is the ideal gas law, $pv = kT$. From it, as from the master law in each system, the lesser laws of the system are deducible in detail.

The master law of the second system is the law of distribution of energy in the line spectrum of an "excited" gas, for this clearly reflects the statistical distribution by state of its variable units, when that depends at once upon energy level maintained in the system and the pressure to which it is subjected. The curves setting forth its variations for a particular gas in different states of excitation will differ only as the curves of distribution of energy in the thermal spectrum differ with temperature, or those for the continuous x-ray spectrum differ with excitation potential, or as the logistic curve differs from popula-

[3] A. J. Lotka, "Elements of Physical Biology," pp. 305–306, 1925.

[4] W. H. Longley, SCIENCE, lxxiii, 1904, pp. 700–702, June 26, 1931, and *Anat. Rec.*, 51, pp. 89 and 113, November, 1931.

[5] C. H. Payne, "Stellar Atmospheres," pp. 23 and 101, 1925.

[6] H. D. Babcock, *Astrophys. Jour.*, lxvii, 230–261, 1928.

[7] C. H. Payne, *loc. cit.*, p. 144.

tion to population of one sort grown under different conditions.

The master law of the simple population has been discussed in full above. That of the second-order population, in addition to the gas laws' horologues. but the law of the logistic curve holds also in this population, in addition to the gas laws' homologues.

In conclusion we summarize the findings in this and preceding brief notes in SCIENCE a possible reader may perhaps, for obvious reasons, best take up in reversed chronological order.

The grouping of organisms in genera and species is justified by the order of nature. Taxonomy is a science, not an art. There is a definite mode of growth of knowledge of species in their genera and their ranges, from which it appears that evolution is a fact and its process Darwinian in principle. The differentiation of genera and species in a great natural group of organisms occurs according to a law affiliated with the gas laws and others, and is as capable as any of mathematical expression. These all are the laws of physical systems readily characterized, and associated naturally under the terms of an amplified kinetic theory.

W. H. LONGLEY
GOUCHER COLLEGE

RATE OF SEA CLIFF RECESSION ON THE PROPERTY OF THE SCRIPPS INSTITUTION OF OCEANOGRAPHY AT LA JOLLA, CALIFORNIA

ABOUT two years ago measurements were made of the amount of recession of three cliffs on the property of the Scripps Institution between the years 1918 and 1930, that is, within twelve years. The results of the study were included in the report of the committee on features and changes of the shoreline of the Pacific Coast, Division of Geology and Geography, National Research Council, May 3, 1930, and they were distributed in mimeographed form, but there appears to be doubt as to whether the appearance of the results in the report mentioned constitutes publication. Since much interest has been manifested in the study it seems desirable to remove any doubt regarding publication. A summary of the results is as follows:

The first cliff is 21 feet high and it had receded 20 feet since 1918. The second cliff is 33 feet high and it had receded 15 feet since 1918, and was undercut at the time the measurement was made to a depth of 8 feet. The third cliff is 54 feet high and since 1918 it had receded between 10 and 12 feet. The heights of these cliffs were plotted as abscisses on coordinate paper and the amount of the recession as ordinates. The equation for rates of recession in terms of height was determined by Dr. G. F. McEwen, of the Scripps Institution. It is $y = 138\,x^{-.625}$

Dr. McEwen has prepared a table of cliff heights in feet and rates of recession in feet per year according to this formula. It is as follows:

Height = x	Recession rates = y	Observations	
		Height	Recession in 12 yr.
5	4.100		
10	2.650		
15	2.080		
20	1.720	21	20
25	1.490		
30	1.330	33	15
40	1.100		
50	.960	54	11
75	.740		
100	.620		
150	.470		
200	.400		
250	.340		
300	.300		
400	.250		
500	.220		

The material, composing the cliffs studied, is a non-indurated clay loam, but the lowest bed in the highest cliff is fairly tough, argillaceous, sandy material with considerable calcium carbonate cement. It appears that the rate of erosion of the loam is not faster than that of the basal bed of the cliff.

It scarcely needs to be said that, although measurements such as are given above are of interest, before entirely satisfactory conclusions can be reached there should be a much larger body of data.

T. WAYLAND VAUGHAN
SCRIPPS INSTITUTION OF OCEANOGRAPHY,
LA JOLLA, CALIFORNIA

BOOKS RECEIVED

Carnegie Institution of Washington. Year Book No. 30. Pp. xix + 505. The Institution.

FORTUNE, R. F. *Sorcerers of Dobu.* Pp. xxviii + 318. Illustrated. Dutton. $5.00.

HERSKOVITS, MELVILLE J. *Anthropometry of the American Negro.* Pp. xv + 283. 34 figures. Columbia University Press. $4.00.

HUGHES, ARTHUR L., and LEE A. DUBRIDGE. *Photoelectric Phenomena.* Pp. xii + 531. 169 figures. McGraw-Hill. $5.00.

LABOURET, HENRI. Les Tribus Du Rameau Lobi. Pp. vii + 510. 31 plates. Institut D'Ethnologie, Paris.

SOHON, F. W. *Introductory to Theoretical Seismology; Part II, Seismometry.* Pp. ix + 149. 26 figures. Wiley. $2.75.

SYMONDS, PERCIVAL M. *Diagnosing Personality and Conduct.* Pp. xvi + 602. Century. $4.00.

VERNON, M. D. *The Experimental Study of Reading.* Pp. xv + 190. 14 figures. Cambridge University Press, Macmillan. $3.00.